

TEACHERS' MANUAL FOR

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New Ideas in Science

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OUR WORLD OF SCIENCE

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TEACHERS' MANUAL FOR

New Ideas in Science

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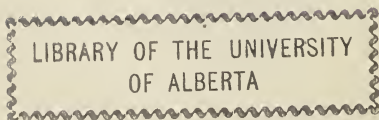
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TEACHERS' MANUAL FOR

New Ideas in Science

FOREWORD: OUR WORLD OF SCIENCE

"It is no longer possible for us to ignore science in the elementary school if we are to discharge our full responsibilities as teachers," a superintendent of schools said recently to his teachers. In these words he expressed the view of thousands of parents in the United States who have become convinced of the great power of science in this modern world.

Unquestionably teachers in the elementary schools wish to meet the growing demand for science. But many of them are hesitant about teaching science because they recognize a weakness in their own background. The basal books in the series **OUR WORLD OF SCIENCE** and the accompanying Manuals have been written to meet the needs of classroom teachers, whether they have had previous training in science or not. The program of science presented in this series is one in which teachers can learn science with their pupils.

Reasons for Teaching Science

A moment's reflection is sufficient to indicate that there is no part of the elementary-school curriculum that has more important contributions to make to the present and future welfare of the nation and of the world than has science. In the following paragraphs are discussed briefly a few of these contributions.

Science makes it possible to abolish poverty. Geologists have learned a great deal recently about how to explore the earth for basic material resources. In cases where raw materials for some substances are scarce, chemists have learned ways of making synthetics which will serve all the purposes required of the original substances. This is illustrated in the manufacture of synthetic tires and quinine, for example. Chemists strive to make new substances from raw materials that are found in abundance, such

as clay, farm produce, and coal tar, thus providing new substances at a very low cost. In this way industry is promoted, more people are given employment, and the new materials are made available to increasing numbers of people. Will the children in our classrooms be prepared to utilize wisely the great material resources of the earth?

Science makes it possible for us to eliminate backbreaking toil. A few years ago most of the work of the world was done with muscular energy. Today we have learned to harness vast stores of energy to machines that may be operated by the pressing of a button. These laborsaving devices can be used in our homes, in factories, and on the farm. Tasks which took hours or days to accomplish can now be completed in a simple operation, and thus more hours are provided for recreation. Will our children be equipped to make intelligent adjustment to the vast supplies of energy and new laborsaving inventions which are daily being made available?

Science makes it increasingly possible to improve the health and safety of the peoples of the world. One of the tasks of the children in our classrooms will be to see that the discoveries of the scientist make a life of good health and freedom from accident available to all.

Science makes it possible for hunger to be abolished. Many authorities contend that an ample supply of food can be raised for all the people of the world by using the improved methods of agriculture which have been discovered in recent years. There is, however, a grave danger that humanity will face increasing periods of famine if it does not soon learn to save its great soil resources. Will our children have the vision to plan for an ample world food supply, or will they through ignorance cause new periods of famine?

Everywhere we turn we see science offering to humanity a higher standard of living in the form of improved food supply, recreation, transportation, communication, and health for all. This improvement, secured on a world-wide basis, would eliminate the chief causes of rivalry between nations and would help to promote permanent world peace.

The United States, as a result of recent events, has assumed a unique responsibility for world leadership. American children must be encouraged to have high ideals of service to humanity, and they must know how to put their ideals into operation on a democratic basis. They must be made to realize the responsibilities and opportunities that are theirs because they are Americans. They must discover while they are young the importance of science and must learn how it can be used to promote world welfare.

The record of the past indicates many fatal errors. Depressions, wars, destruction of valuable soils, pollution of streams and waterways, wastage of mineral resources, introduction of crop pests, have left their mark. With them have come needless poverty and ill health. The elementary school today is responsible for the development of a generation that will be wiser than past generations. Children must learn to realize the power that man has secured through science for the development of a civilization superior to their own.

The task, then, of the elementary teacher in teaching science is clear. Failure on her part to open up the avenues of science to the natural drives of children may result in citizens of tomorrow who are poorly prepared for the adjustments and responsibilities of the atomic age.

The Use of Books in the Teaching of Science

As much as possible the teacher should work with the children while they work, read with them while they read, discuss matters when they discuss them. In other words, the teacher should be a member of the group, learning with the children in a natural situation instead of watching their activities as a bystander or outsider. In all this work the basal book in science can lead to dynamic motivation and vitality of instruction.

The Development of an Informal Working Situation. An informal working situation in teaching science brings good results. It provides an opportunity for children to express their own ideas and to develop lines of interest.

This need not be interpreted, however, as a loose and undisciplined procedure. Science in itself has its discipline, which grows out of the scientific method and attitudes, and the teacher¹ should be keenly aware of the relation of method and attitudes to desirable social behavior in children. If this awareness is applied in science teaching, the teachers of a school should discover, in the work from the first grade through the eighth, a marked improvement in the ability of children to work together on problems.

In the teaching of science both teacher and children should feel relaxed. Much of the austerity found in American classrooms grows out of pressure and haste, which are not in keeping with the rhythm and tempo of child life. If the teacher will remember that the very nature of science calls for discovery and open-mindedness, she will lose the fear of admitting an error in her own thinking. She need have no reluctance in stating frankly that she is learning with her pupils and that there are many things she does not know. The true scientist is learning when he is making discoveries.

Reading in Science Teaching. Reading in the science book should lead to other types of activities, such as discussion, performing an experiment, and planning a science excursion. These activities in turn will cause the children and teacher to go back to the basal book or to supplementary material for information and for new interests and subjects. Many teachers find oral reading useful in science teaching.

As much time as is needed should be taken to clear up each thought. The teacher should allow the child to work important ideas found in the basal books into his thinking through the use of such basic drives as curiosity, imagination, and manipulation. The use of children's natural drives need not place the teacher in an embarrassing position, since in an informal teaching situation children can help one another.

It should be noted that this kind of work does not call for rapid reading. In fact, it may mean slow reading, with much

¹Gerald S. Craig, *Science for the Elementary-School Teacher*, pp. 13-19, 30-36. Ginn and Company, Boston, 1940.

consideration of a single sentence, paragraph, or page, and the relating of content to the children's observations and experiences. The way in which children should use books in science is quite different from the way in which they read a book of fiction, such as a storybook. In science one is seeking truth, and truth is not secured through superficial reading.

Discussion and the Use of Basal Books. Discussion in science can grow out of the use of books. A child or the teacher may have a question about something that has been read. There may be an incident which a child or the teacher wants to add to illustrate a point. Someone may attempt to explain a statement or to add more content to make a point clear. Another may propose the making of a sketch or other art work to illustrate a point. In all this, books will serve to stimulate discussion. Basal science books will be useful also in checking the accuracy of the discussion.

A discussion may last only a few minutes, or it may profitably continue for some time. Teachers should strive toward the improvement of discussion; with younger children discussion is fragmentary and impulsive; with older children it may be characterized by high qualities of critical-mindedness and intelligent planning. Children can secure no small training in learning to discern the difference between reliable and unreliable information as a result of science education in the elementary school.

In teaching science we are concerned primarily with how to find the truth. The process of finding the truth is one that the teacher must share with the children. An authoritative book in the hands of a child serves to assist both him and the teacher in discovering the truth. The teacher should ask from time to time such questions as these: "How can we find out? Are you sure? How can we get the answer? Can you prove it? Why do you say that? How much of what you said is true? What does it mean to you?" It is to be noted that the teacher's primary task is not to answer questions but to help the children find the solution.

Experiments and the Use of Basal Books. Children in the elementary school should become aware of the meaning of experi-

mentation. OUR WORLD OF SCIENCE is filled with suggestions of experiments which can safely be performed by children with equipment that can be obtained in any community. An experiment should be seen as something more than a funny trick or magic. Attention should be focused on what the experiment is to prove. Discussion forms an important part of experimentation in science. It is frequently wise to repeat experiments. Finally, the conclusions developed through the use of experiments should be checked with authoritative books whenever possible.

Field Excursions and the Use of Basal Books. At all times the content of the book should be closely related to what is going on in the community. One means is the field excursion. A field excursion may be short or long, depending on its purpose and the locality to be visited. Sometimes a trip may be made to the heating plant in the school basement, to the fuse box, to a fire extinguisher in a near-by hall, to some vantage point to observe the change of seasons, or to a suitable place to observe the clouds and weather changes. It frequently is advisable to make a trip again after an interval in order to note changes. This is particularly true in studying seasonal changes or the procession of weather changes.

Vacant lots, quarries, gravel pits, road cuts, plowed fields, meadows, woods, orchards, barnyards, are particularly good places for observation. The study of construction work, such as that of new buildings or new highways, power lines or telephone lines, provides opportunity for observation for children at all levels. Then, too, the work of the custodian or janitor of a school building has its scientific aspects, which give children opportunity for useful observation. How the various services, such as water, gas, telephone, electric power, enter a building is usually fascinating to children. In this work the janitor can be of valuable assistance to the teacher and children.

Children may need to collect material on a field excursion. This should be done only with a sensible view of conservation in mind. One of the most important meanings of science is the wise utilization of materials—conservation. Plants and animals

should not be brought into the classroom unless they are to be studied and cared for properly.

It is not necessary that the teacher be able to identify the various plants and animals by name in order to conduct a successful excursion. Many good field excursions have been conducted in the elementary school with only a minimum of identification. As a matter of fact, very few scientists or naturalists are capable of identifying exactly a wide range of objects.

New Challenges Needed from Time to Time. While emphasis has been placed on thoughtful rather than on rapid reading, the teacher should be on the alert to see that the work proceeds at a pace challenging to the children. One way to accomplish this is to move on to new aspects of the subject under consideration or to new subjects. A function of a good science book is to provide new, challenging, and vital subjects for children. Careful observation of the behavior of children will give the teacher indications of whether the children are ready for new material.

Science for All the Children

This discussion suggests how important it is that everyone in a democracy, whether scientist or layman, should have an understanding of the place of science in society. Science is a powerful tool which can be used for good or for evil. If democracy is to survive, the common people must become aware of the potentialities of modern science in a world community. To produce this awareness seems to be uniquely a task for the elementary school, since the elementary school is the school of the people. The teacher, then, will need to make certain that science is made to function in the thinking of all the children. In this way the elementary-school teacher becomes an important factor in the destiny of our nation and the world.

GERALD S. CRAIG

Science in the Classroom

There are many and varied science experiences which help to satisfy the natural curiosity of an eleven-year-old or twelve-year-old concerning his environment. Through science he can gain basic understandings that will give him a greater feeling of security.

Science provides challenging problems for a child which he can solve by firsthand experiences. We assist a child in his attempts to interpret the world about him by observing his methods of solving problems. We help him to learn that he must seek facts before arriving at conclusions, and so we guide him to better methods for attacking future problems.

In addition to helping a child to become familiar with the changes going on about him, science experiences provide opportunities for the development of outstanding attitudes toward which all teachers are working.

IF YOU HAVE NEVER TAUGHT SCIENCE

Teachers need not be hesitant about working in a field of science which is new to them. No teacher or scientist could answer all the questions that children ask. For example, many children ask teachers to identify insects. Some scientists estimate that there are more than a million kinds of insects, some of which have not yet been classified.

As the most experienced member of the group, you can show children how to find answers to questions. Perhaps you do not know the answer to a given question. Through telling children that you do not know and by working together with them to find out, you can help them to become aware that much knowledge remains to be discovered.

You will find answers to questions which will arise in connection with science material in *New Ideas in Science* either in the text itself or in this Manual. More complete background material

may be found in *Science for the Elementary-School Teacher*, by Gerald S. Craig.

SELECTING A TOPIC

The subject matter in the text has been selected with the following factors in mind:

Importance toward functional understanding of child's environment

Interest to child

Opportunity for firsthand science experiences

Suitability to age level

Opportunity for the development of desirable attitudes and appreciations

Ways of Working

INTRODUCING A SUBJECT

Initial interest in a subject has been shown to be very important. Field trips, motion pictures, demonstration experiments, pictures on the bulletin board, a story with a problem, questions, or other means suggested in this Manual may be used to stimulate interest in subjects you may wish to introduce.

Sometimes children bring objects to class and raise questions about them, thus introducing a new subject. Science experiences should be organized, but not to such an extent that there is no time for incidental experiences.

DISCUSSION

Initial discussions may result in a recorded group of questions which children wish to answer during their study of a subject. Such a list will serve to clarify the problem. Experiments have shown that there is better learning when children have specific questions in mind before they begin to read.

Children should learn to discover facts before attempting to answer these questions. Even if some children know the answers, they should not be permitted to give them until investigations have been made.

Frequent discussions during the development of a subject are vital. Through them, teachers should strive to encourage various aspects of growth.

READING

You will probably wish to follow your initial discussion of a problem by reading. Children need guidance in using books. Have your class read portions of the text together so that they can discuss and experiment as they read.

In some cases you may wish to help children to make an outline of a chapter directly from their books either before or after they have read about a topic.

Additional activities are suggested in this Manual for those children who are rapid readers.

EXPERIMENTATION

Elementary science experiments, or experiences, should be used whenever possible to help to clarify a problem. Do not depend on demonstrations; let your group have the benefit of discovering answers for themselves.

All science experiments must be carried out under known conditions and with controls so that results will be accurate. Since children frequently draw false conclusions from experiments, they should always check results. They may wish to repeat experiments. Even so, all science experiences should be accompanied by reading and discussion.

OBSERVATION

Another kind of science experience is observation. This is usually directed by specific questions. So guide the members of your group that they will be more keenly aware of the world about them.

FIELD TRIPS

Although many natural phenomena can be exhibited in the classroom, teachers will benefit by making the whole community

their laboratory. Whenever possible, take your class to see the things which they are reading and talking about. Careful planning before each field trip and discussion and summarizing after the trip are essential.

EVALUATION

One type of evaluation is the development of subject-matter concepts. Examples of objective tests and other methods of measuring the acquisition of facts are included in the following pages.

The second and perhaps more difficult but more important type of evaluation involves desirable development of factors such as the following:

attitudes	application of science principles
appreciations	growth in thinking ability
interests	accurate observation
awareness	evaluation of authenticity
co-operation	higher standards of achievement
self-expression	ability to discover facts
	wholesome attitude toward nature

Evidences of these factors may be observed from the time when a subject is first taken up to the summarizing of what has been learned.

I. GETTING ACQUAINTED WITH MOLECULES

Scientists are able to make our lives more comfortable because they have studied the matter of which our world is composed. Though this matter is a part of the environment of every child, few children know much about it. They may be more or less aware of the existence of the three states of matter: solids, liquids, and gases. Boys and girls are familiar with the way solids, liquids, and gases change from one form to another. They ask How? and Why?

One of the goals of this chapter is to help children to understand the nature of molecules and the theory which scientists offer to explain boiling and freezing in terms of these molecules.

MEANINGS FOR CHILDREN

All substances are solid, liquid, or gaseous. A solid has a definite size and shape. A liquid has a definite size but takes the shape of the container into which it is poured. A gas has no definite size or shape. Substances can change from one form to another. Many of the materials which we use daily illustrate this. All solids, liquids, and gases are composed of molecules, which are extremely small particles. These molecules move constantly. Increasing the speed of this motion sufficiently will cause a substance to change from a solid to a liquid or from a liquid to a gas.

GENERAL INFORMATION FOR THE TEACHER

These facts may prove useful to you in helping children:

A molecule is the smallest unit of a substance which retains the properties of that substance. If we subdivide any substance long enough, we come ultimately to particles that cannot be subdivided any further. These are molecules.

Every substance is composed of molecules. It is not correct to say that substances contain molecules, because they are composed of nothing else but molecules.

Scientists believe that molecules are constantly in motion. The average rate of speed of individual molecules in air is about 500 yards per second. Heat increases the rate of this motion. Molecules of steam in a boiler may move at a rate of 1000 yards per second. Because of the minute size of molecules we cannot see their motion. Boiling, evaporation, and diffusion are evidences of it.

Molecules vary in size. A molecule of olive oil is a large molecule whose diameter is about 25 millionths of an inch. A water molecule's diameter is 1.8 hundred-millionths of an inch.

Since molecules are so small, they must be exceedingly numerous. Scientists have estimated that the molecules in a pint of water placed end to end would form a chain capable of encircling the earth over 200 million times. If these molecules were scattered evenly over the land surface of the earth, there would be nearly 100 million molecules to every square inch of land.

Every molecule of matter is composed of one or more particles called atoms. (See page 18 of this Manual for further information about atoms.)

POSSIBLE APPROACH

Pages 5-15. To stimulate discussion, boil some water or call attention to the water which has evaporated from an aquarium or a glass. Encourage children to express their ideas about why such changes take place. They will probably introduce the words solid, liquid, and gas. From their discussion you can learn how much accurate information children have about this subject. Let children guess, ask questions, and suggest ways of solving their problems. You may need to emphasize the fact that we are not able to secure positive and reliable information about anything by merely guessing.

Pages 15-20. Give your class an opportunity to do the experiments on pages 15 to 20. Talk together about molecules in motion. Here is an opportunity to discuss the nature of a theory. The theory of molecular motion is not just a guess. Scientists experimented and thought carefully about this problem for a long time.

Then they drew conclusions about molecules and called their ideas a theory. This theory is the best answer they can give. If someone proves that the theory is wrong, scientists will be willing to change their ideas about molecules.

Pages 20-22. You may wish to read these pages with your children. Stop frequently for questions and discussion.

ADDITIONAL ACTIVITIES

1. Make a drawing of a bottle of air using dots to represent the molecules. Make a second drawing to show what happens to the molecules when air is heated. (The molecules move more rapidly and more escape from the bottle.)

2. Write a story about an imaginary world in which water is always a gas.

3. Write a story about a world in which all water is frozen.

4. Plan an experiment which will answer this problem: Water boils at 212 degrees Fahrenheit. When more heat is added, the temperature does not rise. What does happen? (Water boils more rapidly. More molecules go into the air.)

MATERIALS NEEDED

Jars and dishes of various sizes; medicine dropper.

Things for You to Think About (p. 22). 1. Molecules would have to be magnified millions of times before they would appear to be as large as tennis balls.

2. The amount of odor from a solid depends on the number of molecules which leave it, go into the air, and reach our nostrils. Many molecules bounce away from onions, camphor, solid perfume, sachet, and other solids which have much odor.

3. Any solid may be thought of as a frozen substance. Frozen iron is just iron as we know it and is not necessarily cold.

4. 18,900,000,000,000,000,000,000,000.

5. The water which makes the clothing wet evaporates faster when it is warmed because the molecules move faster..

6. Water molecules evaporate from the ink; so the ink becomes

thicker. Eventually only solid material will be left in an uncovered inkwell.

7. The heat from the sun makes water molecules move more rapidly and evaporate faster; less water sinks into the ground.

8. Molecules leave the fragrant flowers and travel to his nose.

9. Molecules from other kinds of food move into the butter, which absorbs them.

More Things to Do (p. 23). The snow, water in the lake, rain, and water vapor in the air are composed of water molecules.

1. As solid water, or snow, changes to liquid water, molecules move more rapidly.

2. When water evaporates to become water vapor, the speed of molecules increases. Molecules in gases are traveling more rapidly than molecules in liquids.

3. As clouds form, gaseous water changes to tiny drops of liquid water; so the speed of the molecules is decreased.

EVALUATION

Use "Things for You to Think About" and "More Things to Do" to evaluate what children have learned. Listen for incorrect statements as children discuss the answers to these questions.

Watch for evidences of better scientific attitudes in your group. Are children willing to change their ideas when proved wrong?

Watch for individual progress in participation in discussions and in ability to organize thoughts and to draw conclusions.

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

carbon dioxide (kär'bôn dī ôk'sīd). A heavy colorless and odorless gas.

dry ice. Dry ice is frozen carbon dioxide pressed into blocks.

electron microscope (êlêk'trôn mī'krô skôp). A recently invented microscope that magnifies one hundred thousand times.

gas (gās). Any substance whose molecules move so rapidly in all directions that it has no shape of its own and tends to expand indefinitely.

influenza (ĩn flō'ên'zá). An epidemic disease affecting the nasal passages, throat, or bronchi and accompanied by fever.

liquid (lĭk'wĭd). Any substance that flows and will take the shape of the container into which it is poured.

liquid air. Air condensed into liquid form by cooling and compression.
 molecules (mōl'ê kūls). The smallest particles into which a substance can be
 divided without changing the nature of that substance.
 mercury (mûr'kū rî). A heavy liquid metal.
 solid (sōl'id). Any substance that has a definite shape of its own.
 virus (vî'rûs). Poisonous substances that cause disease.

Key to Pronunciation

ā as in hāy	ē as in bēgin'	ô as in hôrse	oi as in boil
ă as in chăot'ic	ě as in nět	ō as in tōp	ōō as in tōōk
â as in dâre	ĕ as in si'lĕnt	õ as in sōft	ōō as in mōōn
ã as in căt	ē as in mak'ēr	õ as in occur'	ou as in out
ǎ as in in'fănt			ng as in sing
ä as in bärn	ī as in rīde	ū as in mūsic	th as in thin
â as in grăss	ĭ as in gĭft	û as in for'mûla	th as in that
ā as in sofā	ĭ as in dĭrect'	û as in bûrn	tû as in na'tûre
		ÿ as in ÿp	dû as in ver'dûre
ē as in hē	ō as in jōke	ÿ as in cir'cûs	zh as z in azure
ĕ as in hĕre	ō as in ôbey'		

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For the Teacher

CRAIG, GERALD S. *Science for the Elementary-School Teacher*, pp. 190-191, 213. Ginn, 1940.

For the Children

PARKER, BERTHA M. *Solids, Liquids, and Gases*. Row, Peterson.

BOOKLETS²

RCA *Electron Microscope*. Illustrated. Free. RCA Victor Division, Radio Corporation of America, Camden, New Jersey.

FILMS³

Molecular Theory of Matter*

¹For addresses of publishers see page 86.

²Suggestions for securing free or low-cost booklets are listed at the end of each chapter. Since such booklets are most valuable as teaching aids if they are used at the time when a subject is being discussed, it is practical to place your application for a booklet about a month before you plan to use it.

³See page 86.

*Films so marked may be somewhat advanced in treatment; hence particular care should be taken in preparing the class for the presentation of such films.

II. STUDYING THE MOLECULES WITH THE CHEMIST

This chapter further enlarges the child's knowledge of matter. One of the purposes of this chapter is to make children more conscious of the part which chemistry plays in their daily lives.

Many children play with chemistry sets and think of their "experiments" as tricks or magic. Chemistry hobbies can, with proper guidance, become real science experiences. Their value lies in the child's solution of problems by careful thinking. In order to understand experiences with chemicals, children must have basic knowledge of elements, compounds, and mixtures, and the molecules which make them.

MEANINGS FOR CHILDREN

All the kinds of molecules in the world are composed of one or more of 96 elements. Elements combine in many ways to form innumerable compounds. Elements and compounds mix to form still more kinds of substances. Oxygen is the most plentiful element in the world; it is a part of almost everything we touch. Hydrogen is the lightest element. The elements carbon and oxygen are present in carbon dioxide. Radium is an element with unusual properties. The elements in many kinds of molecules are being rearranged as different molecules are formed. Chemists have learned to make many kinds of molecules which have never existed before.

GENERAL INFORMATION FOR THE TEACHER

The most abundant of the 96 elements in the world are oxygen, silicon (found in sand), aluminum, iron, calcium, sodium, potassium, and magnesium.

Elements combine in definite proportions by weight to form compounds. Water is a compound of hydrogen and oxygen. Table salt is a compound of sodium and chlorine. Compounds do not have the same properties as the elements from which they are formed. Compounds are made of molecules that are different from

the molecules in the elements from which the compounds are formed.

All the molecules of one kind of element are the same. All the molecules of one kind of compound are the same. In mixtures there may be many kinds of molecules in any proportion.

The smallest part of an element is an atom. Compounds always contain more than one kind of atom because they are made of more than one kind of element. A compound may be composed of many kinds of atoms or elements.

An element cannot be decomposed by ordinary chemical means. Elements are made of only one kind of atom. When atoms are broken apart, or smashed, great amounts of energy are released.

POSSIBLE APPROACH

Pages 25-34. From a study of the preceding chapter, children will be aware that not all materials melt and vaporize at the same temperatures. Molecules of different substances behave differently because of their composition. Consider the questions What makes molecules different? and Of what are molecules made? Discuss the variety of substances in the world. Scientists tell us that there are now 96 known kinds of elements. How can there be so many kinds of molecules?

Since the subject matter involved in this chapter may be new to most of your children, you may wish to stimulate their interest by reading the beginning of the chapter with them. Allow time for discussion as the reading proceeds. The extent of your guidance will depend upon your group. Do not expect children to be able to distinguish compounds readily from elements and mixtures. Place emphasis on the fact that there can be many kinds of substances in the world because elements can combine in so many different ways.

Pages 34-37. Give your children the benefit of firsthand experiences by letting them do the experiments on pages 34-37. Let them plan and draw their own conclusions. You will need to guide their thinking. Watch for incorrect conclusions. It is desirable

to repeat experiments, to make careful observations, and to check conclusions with authoritative books whenever possible.

The following information will help you to explain the experiments suggested on pages 36-37 of the text:

Epsom salts and ammonia mixed together produce ammonium sulfate and magnesium hydroxide. Magnesium hydroxide is "milk of magnesia."

Washing soda is sodium carbonate. The acid in lemon juice liberates carbon dioxide gas bubbles from the washing soda.

Ask children to compare the new kinds of molecules formed in these experiments with the original ones.

ADDITIONAL ACTIVITIES

1. Hold a penny with tweezers and place the penny in a flame. Copper in the penny will combine with oxygen from the air. This is an example of the combination of two elements, copper and oxygen, to form a black compound, copper oxide.

2. Place a teaspoonful of baking powder in a saucer or in a jar. Add a little water and watch the bubbles. Baking powder is a mixture of compounds. A new compound, carbon dioxide, is formed when the water is added to the baking powder. Carbon dioxide gas causes the bubbles. It makes the holes in a cake, too.

3. Leave some moist nails in a safe place until they have rusted. Scrape some of the rust from the nails and compare it with un-rusted iron nails. Rust is a compound of iron and oxygen. Does the rust feel like iron? Does it feel like oxygen? In this experiment the element iron in the nails and the element oxygen from the air combine. Water hastens the reaction, or chemical change. The compound that is formed does not resemble the elements which are in it.

4. Allow a small amount of cooked egg to remain on a silver spoon for a day. Wash the spoon and notice the dark spots. These are molecules of a compound of silver and sulfur. The sulfur came from the egg. Place the tarnished spoon in an aluminum pan which contains water, a teaspoonful of baking soda, and a teaspoonful of salt. Boil the water. This will clean

the spoon because the sulfur will combine with the aluminum to form a new compound. This process cleans the spoon.

5. Hold a candle flame under a glass. Carbon molecules will collect on the glass.

MATERIALS NEEDED

Pint jars; vinegar; baking soda; half-pint bottles or jars (size not important); candle; matches; Epsom salts; household ammonia; lemon juice; washing soda; penny; tweezers; baking powder; iron nails; silver spoon with egg on it; aluminum pan; table salt; drinking glass.

More Things to Do (p. 42). 1 and 3. No answers required.

2. These elements may not even be listed in a small dictionary.

4. A dictionary or encyclopedia gives properties of these elements. Any high-school chemistry book will give further information about them. The purpose of this question is to help children to realize that elements have widely different properties. The question is not intended to lead children to memorize the characteristics of these elements.

5. Some examples of chemical changes resulting in the formation of new kinds of molecules are these: striking a match, souring of milk, digestion of food, burning wood, making paint, making plastics. When a match burns, certain elements in the match combine rapidly with oxygen, which chemical change we call burning. There are no new kinds of molecules formed when water boils. Steam turns to water when it cools because it is merely water in a gaseous form.

6. Most magazines contain advertisements of synthetic materials in various forms.

What Do You Think? (p. 43) 1. Chemists create new substances to fill the needs of our civilization. They can turn waste products into useful materials. They supply us with synthetic materials when natural resources dwindle. And they produce synthetics that are often less expensive than the things they replace. Some of these are superior in quality.

Frontiers in chemistry are proving to be almost limitless. There

are many fields of exploration, for much remains to be discovered. If one thinks of pioneering as a state of mind, certainly chemists deserve their title "pioneers of plenty."

2. Chemists have improved almost every phase of our lives. Chemistry plays a part in the manufacture of clothing, preservation of food, manufacture of dyes, rubber, fertilizers, paper, medicine, and practically any substance that one can name.

3. Chemists change molecules to make more of the kinds of molecules which are useful to us. They examine substances to discover which elements are in them. Chemists test medicines and food for purity. And they help to prevent changes which are harmful.

EVALUATION

Your group may wish to make an exhibit of synthetic materials or to display pictures of them on the bulletin board. Children have plastic toys, nylon bristles in toothbrushes, rayon material, and the like. Most magazines contain advertisements of new synthetic materials. Help your children to become aware of the many ways in which they use "man-made molecules."

In addition to the discussion which results from the exercise material, you may wish to use an objective test as part of your evaluation to ascertain whether or not the needed facts are known. It should be remembered that the mere possession of facts does not insure understanding or ability to reason with them. Certainly facts are needed for reasoning and for the development of large ideas; but evaluation of learnings should not be based solely on ability to remember facts.

In the following test the pupils are simply to write *True* or *False* after each sentence. The correct answers are here given.

1. Molecules of oxygen are moving in the air. (*True*)
2. The element hydrogen can be made by combining helium and carbon dioxide. (*False*)
3. Carbon dioxide is a gas in the air. (*True*)
4. There are fewer than one hundred elements. (*True*)
5. Elements can mix with one another. (*True*)
6. Carbon is a mixture of compounds. (*False*)

7. Radium is an element which is very rare. (*True*)
8. When a match is struck, new kinds of molecules are formed. (*True*)
9. All man-made molecules are imitations of natural ones. (*False*)
10. Scientists have learned all there is to know about chemistry. (*False*)

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

atoms (ă't'ŭms). The unit particles of which elements are composed. *See also* compound.

Bakelite (băk'ě lit). A product of coal-tar, used for electrical insulation and as a substitute for hard rubber.

cellophane (sěl'ô făn). A wrapping material the basis of which is the cellulose of plants, such as cotton.

chemist (kēm'ist). A scientist who deals with the composition of substances and their transformations.

chlorine (klō'rīn). A poisonous gas which is an element of many compounds, among them common table salt.

compound (kôm'pound). A molecule of a compound is composed of two or more atoms of different elements. Thus, every molecule of the compound *water* consists of two atoms of hydrogen to one atom of oxygen. Hence the chemical formula for water is H_2O .

dysprosium (dīs prō'shī ŭm). One of the rare-earth metals.

element (ěl'ě mēnt). Any of the known 96 simple substances that constitute all matter.

gadolinium (găd ô līn'ī ŭm). One of the rare-earth metals.

helium (hē'li ŭm). A noninflammable gaseous element.

hydrogen (hī'drô jěn). An inflammable gaseous element, the lightest of all substances.

iodine (ī'ô dīn). A nonmetallic element.

lucite (lū'sīt). A plastic substance used in making many useful articles.

nitrogen (nī'trô jěn). A colorless gaseous element which constitutes about four fifths of the atmosphere.

nylon (nī'lôn). A textile fiber made from coal, air, and water.

oxygen (ök'si jěn). A colorless gaseous element which constitutes about one fifth of the atmosphere.

pitchblende (pīch'blēnd). A bluish-black ore which is the source of uranium and radium.

plutonium (plōō tō'nī ŭm). An element recently brought to light by research in atom-splitting.

radium (ră'dī ŭm). A rare element, very useful in hospitals and industry.

rayon (ră'ôn). A textile fiber made chiefly from wood pulp and cotton.

sulfanilamide (sŭl fā nīl'ā mīd). A recently developed drug highly valuable in fighting certain diseases.

tenite (tēn'īt). A plastic substance from which many useful articles are manufactured.

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The Stuff Our World Is Made Of. Little Science Series. Free in quantity. Westinghouse School Service, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

FILMS

Chemistry and a Changing World
New World through Chemistry (du
Pont¹)

Romance of Radium (AMNH)
New World of Chemistry (du Pont)

¹See page 87 for addresses of indicated film sources.

III. NEW IDEAS ABOUT OUR EARTH'S NEIGHBORS

Most children are curious about the objects they see in the sky. Comic strips and storybooks provide strange and highly picturesque ideas about life on other planets. Astrologers would have us believe that the other planets have some blind influence on our lives. Children should learn to recognize authoritative information. Teachers can do much to prevent belief in superstition by helping children to distinguish between astronomy and astrology.

Another goal of this chapter is to help children to realize that space is vast and that the solar system is large compared with our earth.

MEANINGS FOR CHILDREN

In addition to the earth, eight other planets are traveling around the sun at rapid speeds. The sun, a middle-sized star, is many times larger than any of the planets. The sun plays an important part in determining the conditions on each of them. The amount of heat and light from the sun, water, and gases in the atmosphere determine the possibility of life. Conditions necessary for living things exist only on the earth and possibly on Mars, where some astronomers believe low forms of plant life exist.

Several of the planets have satellites, or moons, traveling about them. The earth's moon appears to change its shape because we do not always see the lighted half of it. This mountainous body is without water or atmosphere. No living thing could exist on the moon.

Other bodies in the solar system are not suitable homes for life as we know it. Asteroids, the small planets which travel around the sun between the orbits of Mars and Jupiter, are without atmosphere. Comets are probably composed of poisonous gases and very small particles of solid material. Meteors are white-hot pieces of rock which have been pulled into the earth's atmosphere.

The movement of all astronomical bodies is profoundly influenced by an attraction between them which we call gravitation.

Even though conditions very unlike those on the earth exist on these celestial bodies, we need have no fear of them.

GENERAL INFORMATION FOR THE TEACHER

The earth rotates on its axis every twenty-four hours, at a rate of about 1000 miles per hour, at the equator, causing day and night. The earth makes one complete revolution around the sun each year. The sun is carrying the earth and other planets through space at a rate of 13 miles per second.

Gravity pulls us toward the center of the earth. There is gravitational attraction between the sun and the earth and between all astronomical bodies. The amount of pull depends upon the mass of the bodies and the distance between them.

The sun is the only star in the solar system. Planets are solid bodies which shine by reflected light. Nine of these bodies travel in paths, or orbits, around the sun. Some planets have moons which revolve around them as they journey around the sun.

Mars is the only body other than the earth on which scientists believe there is a possibility of life. Scientists do not agree about life on Mars. Some believe there is none; others think low forms of plant life exist.

On the earth the temperature varies between 149 degrees above zero and 130 degrees below zero Fahrenheit. Life is abundant in only a small part of this temperature range, between 30 degrees and 100 degrees Fahrenheit.

Comets travel in elliptical paths around the sun. They are composed of gases and possibly small solid particles. As they approach the sun, a long tail develops which reflects the light of the sun.

Meteors, commonly called shooting stars, are solid particles, usually of iron and nickel and very small, which reach the earth's atmosphere. As they rush through the atmosphere, friction with the air causes them to burn and shine. If a meteor reaches the earth before it is completely burned, it is known as a meteorite.

When the moon is in a straight line between the sun and the earth, we have a solar eclipse. When the earth is in a straight

line between the moon and the sun, we have a lunar eclipse. The moon's orbit around the earth makes an angle with the earth's orbit around the sun; therefore we do not have two eclipses each month. The moon is usually too high or too low to cause an eclipse.

The following information may help children to appreciate the vastness of a million miles: To *write* to a million, writing steadily 8 hours a day, 7 days a week, at the average rate of 2 digits a second, would take approximately 3 months, 2 weeks, and 2 days.

POSSIBLE APPROACH

Pages 45-48. Before considering our neighbors in the sky, help children to visualize the movements of the earth by reading pages 45 to 48. Let children suggest ways of solving the problems on page 48. The earth revolves around the sun at a rate of 1100 miles per minute, about 66,000 miles per hour, or approximately 1,600,000 miles per day.

If children are not familiar with the motions of the earth, the following demonstration may help them. Use a candle or a flashlight to represent the sun. Ask a child to carry a globe around the "sun," showing how the earth rotates on its axis in a counterclockwise direction and how it revolves around the sun in a counterclockwise direction. Imagine that the "sun" too is moving through space and carrying the earth with it. Thus the earth is moving in three ways.

Pages 48 to 85. To discover what the children in your group think about the objects which they see in the sky, you may wish to ask them what they would expect to find if they could board a rocket ship and travel far from the earth. Such a discussion will reveal ideas which children have about objects in the sky. After a free discussion the group might make a list of questions which they would like to answer. Some of the following might be included:

Does anyone live on Mars?
How big is the sun?
Why does the moon change its shape?

Are there flowers on the planets?
What are comets?
What are shooting stars?
Is the moon a planet?
What makes the rings around Saturn?
What is the difference between a star and a planet?

Use this chapter about the sun's family for information that will answer the questions which children have proposed. While discussing questions about the possibility of life on other planets, emphasize the conditions necessary for life. All living things must have oxygen, water, proper temperature and pressure, and a food supply.

ADDITIONAL ACTIVITIES

1. You can allow for individual differences by appointing rapid readers to a committee which will make the chart suggested on pages 50-52.

2. Children with special interests may wish to report on topics from supplementary books.

3. Make a model of the surface of the moon by following these directions: Put a thin layer of petroleum jelly or other grease on some marbles and on a flat piece of glass. Mix about three tablespoonfuls of plaster of Paris with a little water. Quickly pour the plaster on the glass. Try to copy a picture of the surface of the moon by molding the plaster to make mountains. Drop marbles in the plaster to make the craters. When the plaster dries, remove the marbles.

4. By comparing the length of a year on the earth with the length of years on other planets, find out how old you would be if you lived on each of them.

5. If possible, visit a planetarium or an observatory. Polar caps on Mars, sunspots, rings around Saturn, and markings on the moon can be seen with telescopes, depending on the magnifying power of the instrument used.

6. Using the chart on page 52, calculate how long it would take to travel from the earth to each of the planets in a plane, traveling

500 miles an hour. Use this information to make a chart or a mural.

MATERIALS NEEDED

Piece of wrapping paper 17 feet long, about 3 feet wide, or several pieces of paper tacked or pasted together; yardsticks and rulers; heavily smoked glass for looking at sun, or dark film negatives; globe; candle, flashlight, or light bulb on extension cord; 27 birthday candles; piece of glass on which to stand candles.

More Things to Think About (p. 85). 1. A person traveling to the moon would need a supply of oxygen, water, and food, since none of these are found there. An air-conditioning unit would make life more comfortable because of the extreme changes in temperature.

2. See pages 55 to 79 of the text.

3. Length of a day (compared with one on the earth):

Mercury	88 days
Venus	Unknown
Earth	1 day
Mars	1 day
Jupiter	10 hours
Saturn	10 hours
Uranus	11 hours
Neptune	16 hours
Pluto	Unknown

4. Number of moons:

Mercury	0	Saturn	9
Venus	0	Uranus	4
Earth	1	Neptune	1
Mars	2	Pluto	0
Jupiter	11		

The pull of gravity is greater on the larger planets than on the smaller ones. Mercury and Pluto are probably too small to hold moons.

5. The ancients thought that meteors and comets were signs of coming good or evil. They believed that these bodies were supernatural and had an influence on the lives of people. Many worshiped the sun as a god. Children may wish to gather further information from mythology books.

6. Planets would fly into space if the sun lost its power to hold them in their orbits. Stars would cease to attract one another and would lose their relative positions, thus producing celestial chaos. Without gravity everything would fly off the earth.

7. Dividing the distance of each planet from the sun (table, p. 52) by the diameter of the planet (table, p. 51), the diameter seems very small indeed as compared with the distance from the sun.

8. The sun is 92,760,000 miles farther away from the earth than the moon is, or about 390 times as far away.

9. If the moon were a star, the earth would receive so much heat that living things would not be able to exist.

EVALUATION

Note changes in the ideas which children have about the solar system. Watch for evidences that they recognize superstitions and seek information from reliable sources.

In addition to this you may wish to use the following objective test.

1. _____, _____, _____, and _____ are the four largest planets. (*Jupiter, Saturn, Uranus, Neptune*)

2. The largest body in the solar system is _____. (*the sun*)

3. We know that there is life on the planet _____. (*earth*)

4. Our nearest neighbor in the sky is _____. (*the moon*)

5. The planet _____ is very hot on one side and very cold on the other. (*Mercury*)

6. Sunspots are _____. (*storms on the sun*)

7. The very small planets which travel around the sun between the orbits of Mars and Jupiter are called _____. (*asteroids*)

8. Nothing could live on the moon for there is no _____ or _____ there. (*water, air*)

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

Ahnighito (ä nĩ gē'tō). A famous meteorite.

asteroid (ās'tēr oid). One of a group of tiny planets between the orbits of Mars and Jupiter.

comet (kōm'ēt). A heavenly body, consisting of gases and some solid materials, that goes around our sun displaying a nebulous tail which reflects the light of the sun.

constellation (kōn stē lā'shŭn). A group of fixed stars.

gibbous (gib'ūs). The moon is gibbous (*g* is pronounced hard) when we see more than half of the illuminated side but not the full moon.

gravity (grāv'ī tī). The force that draws all things on the earth toward its center. The pull of all the heavenly bodies upon one another is popularly called *gravity*, though more commonly referred to by scientists as *gravitation*.

Jupiter (jōō'pī tēr). The largest of the planets.

incandescent (in kăn dēs'ēnt). Glowing with intense heat but not burning, like the filament in an electric-light bulb when the current is turned on.

latitude (lāt'ī tūd). Distance north or south from the equator.

Mars (mārz). The fourth planet from the sun.

Mercury (mūr'kú rī). The planet nearest the sun.

meteor (mē'tē ōr). A particle of solid matter which rushes into our atmosphere and becomes hot and luminous because of friction with the air.

meteorite (mē'tē ōr ít). A meteor which is so large that it is not completely burnt up but reaches the surface of the earth.

Neptune (nēp'tŭn). The eighth planet from the sun.

planet (plăn'ēt). One of the solid bodies that go around the sun in regular orbits and receive heat and light from the sun.

Pluto (plōō'tō). The outermost planet of the solar system.

Saturn (săt'ŭrn). One of the larger planets, famous for its beautiful rings.

Uranus (ŭ'ră nŭs). The seventh planet from the sun.

Venus (vē'nŭs). The second planet from the sun.

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Telescopes. Little Science Series. Westinghouse School Service, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

FILMS

Airplane Trip
Earth in Motion

Solar Family*
Moon*

*Films so marked may be somewhat advanced for some groups; hence particular care should be taken in preparing the class for the presentation of such films.

IV. THE OCEAN IS A GREAT STOREHOUSE

No matter where children live, they wonder about the ocean. Even those boys and girls who have never been to the seashore are curious about that vast body of water. This chapter illustrates the variety of conditions in the ocean, the variety in size, structure, and habits of living things in the seas, and the struggle for survival going on in those regions. New uses for the ocean's vast resources increase its importance in everyone's daily life.

MEANINGS FOR CHILDREN

Almost three fourths of the surface of the earth is covered with water. Until recently this water has been a mystery to man. Scientists have learned that the ocean floor is a huge plain with occasional mountain ranges. Some mountains rise above the surface of the water to form islands. Continental shelves extend outward under the ocean from the shores of all continents. These shelves may be only about 10 miles wide or they may extend outward for 150 miles. A steep drop at the end of the continental shelf is called the continental slope. From the shore to the slope, the ocean bottom is covered with sand. Beyond this there is an ooze which is composed of pebbles, dead plants, and the skeletons of millions of tiny animals which have fallen to the bottom of the ocean. Some of the material forming the ooze is from plants called diatoms which live at the surface of the ocean. Seaweed is a much larger plant which floats in the ocean. Large quantities of seaweed are used as fertilizer.

Ocean currents carry seaweed and other plants, as well as animals, with them. Currents affect the climate of many countries.

Corals are small animals whose skeletons form coral reefs in various parts of the ocean. On some islands coral is used as a building material by the inhabitants.

In the upper surface regions of the ocean, far north and south, there are many different types of animal life. Still other varieties are found in the cold, dark depths far beneath the surface. But in all parts of the ocean there is a struggle for food and life. Many

kinds of plants and animals supply the food for the fish and other ocean animals that are eaten by man.

GENERAL INFORMATION FOR THE TEACHER

Almost three fourths of the surface of the earth is covered with water.

The average depth of the ocean is $2\frac{1}{2}$ miles. The floor of the ocean at its deepest point is from 6 to 7 miles from the surface. Still, the ocean is a very thin film on the surface of the earth when its depth is compared with the earth's diameter.

The color of ocean water varies with the depth of the water, the amount of salt it contains, the creatures that live in it, and the quantity of small solid particles it holds.

Most of the ocean floor is flat. There are occasional mountain ranges under the water.

The ocean is salty with many kinds of salt. Rivers traveling over the land year after year dissolve some of the chemicals from the rocks and carry them along. There is some salt in the rivers too, but there is not enough to make them taste salty. Each year about a million tons of chemicals are poured into the sea by the streams flowing into it. The ocean is becoming saltier all the time because salt is left in the ocean when water evaporates.

There is a cent's worth of gold in a thousand gallons of ocean water. So far man has not found a practical method of removing this element from ocean water. Tons of magnesium and bromine are being removed from it for industrial use. Magnesium is a light-weight metal which is used in the construction of airplanes, automobiles, and baby carriages. Bromine is used also in the preparation of ethyl gasoline.

Corals and sponges are frequently but erroneously called plants. Both are simple forms of animal life.

Whales are not fish. Whales are warm-blooded animals that breathe with lungs and bear their young alive. They are classed as mammals.

In the ocean, as on land, animals live by eating plants and by eating each other. Usually the great ones eat up the little ones.

Along the shores and at the surface of the ocean, where food is more plentiful because plants receive the sunlight they need for food-making, there is more life.

POSSIBLE APPROACH

Here is an opportunity for your class to explore the ocean no matter where the children live. You may wish to use one or more of the following ways as an introduction to this chapter:

Look at a map of the world. Note how much water covers the earth.

Show a film about sea life.

If someone in the group has been to the seashore, ask him to describe the ocean. If several pupils have been there, compare their descriptions.

Plan to make a mural of undersea life and the ocean.

Ask boys and girls to tell sea stories which they have read.

Make a list of statements about the ocean which various members of the group believe to be true. Ask children to suggest a method for finding out whether or not the statements are correct.

Your procedure will depend upon which of the foregoing methods you have used.

ADDITIONAL ACTIVITIES

1. Some children may wish to write reports on such topics as sponges, salmon, extraction of magnesium and bromine from the sea, the color of the sea, how the sea became salty, and cables in the ocean.

2. Make a marine aquarium. If you do not live near the ocean, you may wish to obtain the necessary materials from General Biological Supply House.¹

MATERIALS NEEDED

A tall glass; small objects that will float and some that will sink in water; samples of coral and seashore shells. (If children do not supply these, obtain shells from a fish market.)

¹See page 87.

What Do You Think? (p. 118) 1. Corals, sponges, diatoms, seaweed, starfish, crabs, oysters, clams, lobsters, and whales are some kinds that may be named.

2. Water from the surface of the ocean should contain diatoms, seaweed, and other floating plants. Water from the deep sea would contain only a very small number of living things. Water from the seashore might contain green ocean plants, crabs, clams, and other seashore animals.

3. Man uses scientific studies of the ocean in navigation and in industries, such as fishing. Knowledge of ocean currents would help to determine the position of a life raft.

4. Information about heavenly bodies was gathered long before stars were used in air navigation. Studies of atomic structure began long before man learned to use energy from the splitting of atoms. Franklin gathered facts about lightning with no immediate use in mind, but the information he gave us has been put to many practical uses.

5. The Pacific Ocean is the largest body of water on the earth. Water from the Atlantic Ocean flows into the Pacific by way of the Arctic, Antarctic, and Indian oceans.

See answer to question 1 for living things in the Atlantic Ocean. Fish, marine worms, and numerous other animals can be added to the list. Whales, seals, and walruses live in the Arctic Ocean. Children should realize that there is much greater variety of life in warm water.

6. Man is turning to the ocean as a storehouse for chemicals. Large quantities of bromine and magnesium are extracted from sea water and are used commercially. Bromine is needed for manufacturing ethyl gasoline. Magnesium is a light metal and hence is used in airplane parts, automobile parts, and the like.

EVALUATION

Use individual reports and discussion as a means of evaluation.

Play a game of "Information, please." Ask children to write questions about the ocean on slips of paper. Mix the questions in a box and let individuals draw slips and answer the questions

on them. Or ask a committee to answer the questions while the class judges the accuracy of each answer.

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

corals (kōr'āls). Little animals of the sea that form a hard limestone coating about them and live in colonies.

diatoms (dī'a tōms). Microscopic simple plants that are very numerous in the ocean.

ooze (ōōz). The deposit on the ocean floor.

porpoise (pōr'pīs). A sea animal, about six feet in length, belonging to the whale family, sometimes called the dolphin.

Sargasso (sār gās'ō) sea. A warm part of the Atlantic Ocean marked by tangles of seaweed known as sargassum.

tuna (tōō'nā). A large edible fish.

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FILMS

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Shell-Fishing

Beach and Sea Animals

Marine Circus (AMNH)

New England Fishermen

Seashore Animals (AMNH)

The Sea, Battle for Life Series (AMNH)

V. HOW ANIMALS SURVIVE

This chapter supplements the preceding one by increasing the child's understanding of the struggle for survival, which is constantly present in the animal world.

MEANINGS FOR CHILDREN

Animals which take no care of their young produce many offspring. Without care, most of the young die. If they all survived, there would not be room enough in the world for so many animals. Some animal fathers care for their young. Many animal mothers are careful parents. With the exception of man, methods of caring for young have not changed over long periods of time. Man can reason and thus has been able to make rapid improvements in methods of caring for children. Animals have many adaptations which help them in their struggle for existence. Without these adaptations the animals would not survive to produce young.

GENERAL INFORMATION FOR THE TEACHER

Animals which produce extremely large numbers of offspring do not care for their young.

Guppies, zebra fish, sword tails, and many other kinds of tropical fish will breed in an aquarium. Guppies are the easiest to raise and will reproduce every four or five weeks. A pair will produce from 3 to 36 young at one time. The ideal water temperature for these fish is 75° F, but they will live in water that is anywhere between 65° and 80°.

In general, the amount of care increases as the number of offspring decreases. Parental care is usually more highly developed among more complex animals, such as birds and mammals. Man is superior to all other animals in caring for offspring.

Only twenty-eight years ago one baby out of every ten died before its first birthday. Today the rate is less than one in twenty. And over the same period of time the average span of life has lengthened from about 55 years to 64 years.

Adaptations are methods which help animals to overcome difficulties. These, of course, help animals to survive.

Many kinds of animals have special adaptations for food-getting. A squirrel's sharp, strong claws, his teeth, and his mouth muscles are examples of an animal's adaptations for food-getting. The mouth parts of meat-eating mammals are adapted for securing and eating their food. The beaks and feet of birds are other examples. Most animals have specially developed parts, called adaptations, which help them to obtain and eat food.

Living things are adapted for protecting themselves by special devices. Such devices may be body parts suited for fighting or escape, protective coloration, special coverings, offensive odors, or bad taste to other animals that seek to devour them. Numerous offspring might be considered a protective device for survival. Communal living is another adaptation of this type.

POSSIBLE APPROACH

Pages 120-124. Ask children to tell about their experiences with young animals. How does a cat care for her kittens? How do birds care for their young? Perhaps someone will introduce a discussion of animals that do not care for their offspring. Or you can talk about animals illustrated in the picture on page 120. Ask what oysters, flounders, and similar animals do to protect their young. Supplement children's information with the material on pages 120-124.

Pages 124-128. A suitable home for guppies or other tropical fish can easily be made and cared for in a classroom. See Turtlox Leaflets Nos. 5, 23, and 48, available free from General Biological Supply House.¹

Make the boys and girls in your group feel that the aquarium belongs to them. Let them experience the building of the aquarium and take pride in caring for it.

Pages 129-135. If you live in a city, try to take your group to visit a zoo, a bird sanctuary, or a pet shop where children can watch young animals and compare types of parental care.

¹See page 87.

If you live in the country, encourage children to tell about their observations of young animals on the farm.

Pages 135-138. If possible, keep one or two classroom pets for a short time. Rabbits, white mice, guinea pigs, and frogs make suitable pets. Hamsters, ratlike animals sold by biological supply houses, are probably the best pets for the classroom. Pets will afford opportunity for observation of adaptations.

While discussing the last part of this chapter, talk about simple animals as well as the more complex types. Encourage children to provide more illustrations of adaptations.

ADDITIONAL ACTIVITIES

1. Gather information about parental care in additional animal families. Make a chart to show how long the young of these animals must be cared for by adults. Place the names of animals in order, with the one that needs the least care first.

2. If you are right-handed, try to write with your left hand. Do you adapt easily?

3. Find out how some tropical fish build bubble nests.

4. Tell how blind people adapt themselves.

5. Find out how scientists experiment with disease in animals and apply the knowledge which they gain in treating human beings.

MATERIALS NEEDED

Aquarium; guppies or other tropical fish. (If children cannot bring some guppies to school from their home aquariums, you may obtain them from a pet shop or from one of the supply houses listed on page 87 of this Manual.)

What Do You Think? (p. 139) 1. Scientists believe that man is the only animal who has noticeably improved his methods of caring for his young. It takes thousands or millions of years for new adaptations to develop in other animal families.

2. Some examples of adaptations are these: beaver's tail, giraffe's neck, squirrel's mouth and front legs, rat's teeth, snake's poison, bee's sting, leopard's spots, turtle's shell.

3. DDT will kill helpful insects as well as harmful ones. Bees are extremely important because of the part they play in pollination of crops.

EVALUATION

Watch for individual growth by noting contributions to discussions about parental care and adaptations.

Make a broomstick "movie" of the struggle for existence. Some pictures might show what would happen if all the offspring of lower animals grew up. Others might illustrate special adaptations.

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

aquarium (á kwâ'ri ŷm). A vessel filled with water for keeping fish.

chameleon (ká mē'lē ŷn). A lizard that changes its color to match its environment.

crayfish (krā fīsh). The crayfish, also known as crawfish, is a fresh-water animal resembling a lobster, but much smaller.

doe (dō). A mother deer.

kangaroo (kāng gā rōō'). A leaping animal of Australia and adjacent islands which carries its young in a pouch.

ladybug (lā'dī būg). The popular name for the *ladybird*, a small brightly colored beetle that feeds on insects.

porcupine (pôrkū pīn). An animal that relies on sharp spines for protection against enemies.

praying mantis (măn'tīs). An insect, related to the grasshopper, that holds its front legs as if praying.

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EIPPER, PAUL. *Animal Children*. Viking, 1930.

MORGAN, ALFRED. *An Aquarium Book for Boys and Girls*. Scribner, 1936.

BOOKLETS

Aquariums and Terrariums in Your Classroom. Free. Denoyer-Geppert Company, 5235 Ravenswood Avenue, Chicago 40, Illinois.

Free leaflets on how to build and maintain aquaria and terraria may be obtained from General Biological Supply House.¹

FILMS

Sunfish

Snapping Turtle

Beach and Sea Animals

Thrushes and Relatives

Elephants

How Nature Protects Animals

Animal Youngsters (AMNH)

Baby Birds and Their Ways (AMNH)

Jungle Giants (AMNH)

The Sunfish (AMNH)

¹See page 87.

VI. HOW FRICTION HELPS OR HINDERS OUR WORK

Most children have had a great deal of experience with friction but know very little about it. Friction may be an entirely new word to most of the children you teach.

Everyone is affected by friction in his daily life. Whenever there is motion there is friction, for friction is a force which opposes all motion. Children can learn to increase friction when it helps them and to decrease this force when it is a hindrance.

This chapter provides material for problem-solving through observation, reading, experimentation, and discussion.

MEANINGS FOR CHILDREN

Machines help men to do work. These machines use various kinds of energy. A steam locomotive is an example of a machine which works for us. But the locomotive will not run without power because friction stops it. Friction is opposition to motion. If there were no friction in the world, our life would be very different. By rolling things on wheels man decreases friction and makes work easier. Friction always produces two effects, heat and wear. When friction hinders us, we reduce it by lubrication (that is, by applying oil or grease) and by using smooth and hard surfaces for moving parts of machines. When friction helps us, we increase it by making surfaces rougher. Friction is an important force in our daily lives.

GENERAL INFORMATION FOR THE TEACHER

There is friction whenever there is motion; so there is friction whenever work is done.

Friction is the resistance to the movement of one object upon the surface of another.

No surfaces are perfectly smooth. The rougher the surfaces which rub together, the greater the friction.

Friction always produces heat.

Whenever there is friction, some of each of the surfaces in contact is worn away.

We could not get along if there were no friction. We try to increase friction when it is desirable and decrease friction when it is undesirable.

Friction between rolling surfaces is less than friction between sliding surfaces.

Friction between liquids is usually less than friction between solids.

POSSIBLE APPROACH

Pages 141-148. Most children are interested in trains. A steam locomotive looks like a complicated piece of machinery, but it works on a very simple principle.

Some boys and girls in your class may have toy steam engines that can be used as models. You may wish to purchase a cut-away model which shows the inside of a locomotive. Or you can use a bicycle-tire pump to explain the parts in a steam engine. The pump has a piston, piston rod, and a cylinder. The piston moves back and forth in the cylinder in a manner similar to that of the piston in a steam engine.

Show your class a bicycle pump or a model steam engine. Ask the children if they can use this to explain how a locomotive works. Perhaps someone in the group who has made a hobby of trains may offer an explanation. Other children may guess. Suggest that children read to find out. Use the pictures on pages 144-147 and compare them with the model you are using. Discuss the steam engine in a locomotive, emphasizing the fact that this is one illustration of the use of energy to do work for us.

Pages 148-166. Use the story of a "world without friction" to introduce friction to the children. Do the experiments on pages 149, 152, and 156 together. Encourage free discussion of these experiments and of children's experiences with friction. Use this opportunity to guide thinking to definite conclusions.

ADDITIONAL ACTIVITIES

Make a large chart for the bulletin board showing how a locomotive uses steam to turn its wheels.

MATERIALS NEEDED

Bicycle pump; toy steam engine (from toy store); cut-away model of steam engine (from Chicago Apparatus Company); Pyrex nursing bottle with cork to fit; pot-holder; spring balance (from five-and-ten-cent store, hardware store, or Chicago Apparatus Company); sandpaper; block of wood, any size; heavy wooden box or cardboard box full of books; broomsticks (two) or similar rods; Boy Scout fire-drill set; worn roller skate to show ball bearings; ice cube; piece of wire.

More Things to Do (p. 166). 1. A piece of wood is pressed against a wheel. This increases opposition to motion; that is, it increases friction and stops the wagon.

2. The surface of smooth glass is not rough enough to wear away particles from the pencil or chalk. Frosted glass has a rough surface; hence friction is increased and particles wear from pencil or chalk.

3. Answers will vary.

What Do You Think (p. 167) 1. Friction wears small pieces from the eraser and from the pencil mark on the paper. When you write with a pencil, friction causes marks to be left on the paper.

2. If man had not learned to use friction to his advantage, there would be no brakes on moving vehicles, we should not know how to write with pencils or pens, we should not know how to start fires, automobiles would slide along the road and get stuck in snow and sand, and so on.

3. Lubricating oil would reduce friction, and brakes would not stop the car.

4. Friction may be helpful or harmful. In some ways it helps us, and in other ways it hinders us. Man may control friction by increasing or decreasing it to suit his needs.

5. Most accidents in the home are due to slipping, or lack of friction, such as slipping on floors, in the bathtub, or on stairs. Fires may be started by mice gnawing on matches, the friction of the mice's teeth causing the matches to light.

6. Heat from friction is used in making fire. Wear from friction is not useful, except when filing or sandpapering is necessary to secure a desired smooth surface. Heat from friction is undesirable when it causes fires that are not wanted.

7. The surface of the tape is rough; hence friction is increased when you grasp the baseball bat, hockey stick, or tennis racket. Without the tape, they might slip from your hands.

EVALUATION

Consider the questions on page 167. From the children's answers you can learn how well they understand the material in this chapter.

In addition to this you may wish to review the facts that must be known in order to develop an understanding of friction as a helpful and as a destructive force. It is well to keep in mind that the knowledge of these facts does not insure the ability to reason with them.

You may also give the following test. The correct answers are supplied.

After each of these statements the pupil is to write *True* or *False*.

1. All surfaces are somewhat rough. (*True*)
2. When we are doing work, some energy is used in overcoming friction. (*True*)
3. Friction is opposition to motion. (*True*)
4. We could always get along better without friction. (*False*)

In each of these sentences the pupil is to supply the missing words.

1. Friction produces _____ and _____. (*heat, wear*)
2. We decrease friction by _____. (*lubrication, ball bearings, using hard parts, making surfaces smooth*)
3. We increase friction by _____. (*making surfaces rougher, increasing pressure between moving parts*)

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

Archimedes (är kĭ mē'dēz). An ancient Greek mathematician.

cylinder (sĭl'in dēr). A metal tube, used on a steam engine, in which the piston moves back and forth. Any tube so shaped.

friction (frĭk'shŭn). The resistance to the motion of an object resulting from contact with another object.

lubrication (lŭ brĭ kâ'shŭn). Making a surface slippery by means of oil, grease, or similar substance.

piston (pĭs'tŭn). A metal piece, usually a cylinder, that slides back and forth within a larger cylinder.

pyramids (pĭr'ă mĭdz). The Egyptian pyramids are stone structures the sides of which come to a point at the top.

sapphire (săf'ĭr). A blue and much-prized gem.

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HUEY, EDWARD G. *What Makes the Wheels Go Round?* pp. 65-69, 131-135. Reynal, 1940.

BOOKLETS

Large pictures of roller bearings and ball bearings. Free. Timken Roller Bearing Company, Canton 6, Ohio.

FILMS

Story of Lubricating Oil (AMNH) Simple Machines *Thermodynamics

*Films so marked may be somewhat advanced in treatment; hence particular care should be taken in preparing the class before presentation.

VII. ELECTRICITY WORKS FOR US

Most children have had experiences with the sparks that are caused by frictional electricity. Many boys and girls are curious about the causes of lightning, but some are afraid of the flashes they see in the sky. Few children realize that lightning and the smaller sparks referred to above are the same kind of electricity which is carried through wires to their homes. One of the purposes of this chapter is to show how man has learned to use and control electricity. It will help children to understand some of the ways electricity works for us and will show them that they need not fear lightning or current electricity.

MEANINGS FOR CHILDREN

Frictional electricity can be made by rubbing certain surfaces together. Lightning is a giant spark produced by frictional electricity. Man has learned ways of protecting himself and his buildings from lightning and from current electricity. The current electricity that flows through a doorbell makes an electromagnet which pulls the clapper to the gong. Telegraph sets use electromagnets. Man uses heat from electricity in irons, toasters, heating pads, electric heaters, and ranges. Man has improved ways of using light from electricity. Current electricity works for us in many ways.

GENERAL INFORMATION FOR THE TEACHER

Objects which carry electricity easily are called conductors. Objects which do not carry electricity easily are called insulators. A poor conductor may be a good insulator.

Air is a poor conductor; but when the charge is strong enough, electricity causes a spark as it jumps through the air from one object to another.

Water does not attract lightning, but it does conduct it. To determine the approximate distance of lightning, count the number of seconds between the moment you see the flash and the time you hear the thunder, and divide this number by five. Light

travels 186,000 miles a second, whereas sound takes about 5 seconds to travel a mile.

Frictional electricity can be made by rubbing certain substances together.

Children may think that frictional electricity is magnetism. Magnets (iron and steel) will not produce frictional electricity because they are good conductors. Paper, silk, hard rubber, glass, and fur retain an electrical charge, but they are not attracted by a magnet.

Electricity has no color; it is invisible. We see the red-hot or white-hot wire or air which results from the passage of electricity.

Current and frictional electricity are really the same. The source of the electricity and method of traveling differ.

Thin wires resist the flow of electricity more than thick wires do. Electricity flows to and from houses through copper wires. In heating units, such as toasters, irons, stoves, and electric pads, a thinner wire is used. In many appliances this wire is made of nichrome, a combination of nickel and chromium. The additional resistance produces more heat.

Tungsten wire is used in most electric-light bulbs. Tungsten resists the flow of electricity even more than nichrome, making the wire white-hot instead of red-hot.

When electricity flows through certain gases or vapors instead of through a metal wire, light is produced. Thus when it flows through the gaseous element neon, a bright orange-red light is given off. As it passes through sodium vapor, it gives off a yellow light.

Ultraviolet rays are produced when electricity travels through gases contained in a glass tube. These rays are invisible, but when certain chemicals, called phosphores, are painted inside the tube, visible light is given off. Various colors can be produced; combinations of vapors and phosphores produce the blends of color necessary to make white light.

POSSIBLE APPROACH

Pages 169-178. On a clear day hold a smooth sheet of paper against the blackboard. Rub the paper with a board eraser or a

piece of wool. The charge produced on the paper by friction will hold it to the blackboard. Let children do the experiments suggested on pages 169-170. Discuss and compare other experiences with frictional electricity. Encourage free informal discussion about frictional electricity and about lightning. Listening to children's ideas about this subject will help you to understand what they think and how they try to solve problems. Guide their natural curiosity so that, as far as possible, the children themselves may discover answers to their questions.

Pages 178-182. Air is a relatively poor conductor of electricity. Ask your group to suggest better paths or conductors. They will find these as they read pages 178-182.

Pages 183-190. Follow the path of electricity through a doorbell as you read pages 183-186. If children are not familiar with electromagnets, let them make one by wrapping wire around an iron bolt or large nail and then sending an electric current through the wire. Emphasize the fact that the iron remains a magnet only as long as electricity flows through the wire.

Pages 190-198. A question about the color of electricity will stimulate thought. Many children think that electricity is white because electric-light bulbs give off white light and lightning appears to be white. Others contend that electricity is red because electric heaters and toaster wires are red when hot. Let children think about this question as they do the experiments on pages 190-194.

ADDITIONAL ACTIVITIES

1. Find out how electricity gets to your house.
2. Have a play in two scenes which shows the contrast of a day in the life of a family without electricity and a family which has numerous electrical appliances.
3. Arrange to visit a telegraph office. Watch the telegraph operator as he sends messages. Watch the sounder move as messages come to the office. If you go to a large office, watch the people who unwind the tape, clip it, and paste it on the telegrams.

4. Learn the Morse code. You will find it in the Encyclopædia Britannica or other reference book.

MATERIALS NEEDED

Fountain pens; wool (trousers, sweaters, or other clothing); fur (coat collar can be used); silk (clothing can be used); hard-rubber comb; dry cells (from five-and-ten-cent store or hardware store); doorbell (from five-and-ten-cent store or hardware store); nails; magnet wire, 1 spool (from five-and-ten-cent store or hardware store); switch; blocks of wood; metal strips from tin can; toaster or other electrical appliances for observation; worn-out light bulb; old fluorescent lamp tube.

More Things to Do (p. 198). No answers necessary.

What Do You Think? (p. 199)

1.	<i>Insulators</i>	<i>Conductors</i>
	air	air
	water	water
	glass	copper wire
	rubber	silver wire
	wood	nichrome
	sealing wax	tungsten
		people
		special rubber tires

Air and water are in both lists. They conduct lightning because of the amount of the charge. They are usually classed as insulators, however, since only a powerful amount of electricity will travel through them. There is no perfect conductor or insulator.

2. Electricity flows many miles through wires in a very short time. A message from California can reach New York over telegraph wires in a fraction of a second.

3. Children may think that they see electricity when they see lightning or the red-hot wires in a toaster. We see lightning because electricity heats the air as it passes from cloud to cloud or from cloud to earth. In the toaster we see red-hot metal which

was heated by electricity. We know electricity by the way it acts. Electricity heats air, heats wires, makes the wire in a light bulb white-hot, and makes an electromagnet when it flows through a wire that is wound around a piece of soft iron.

4. The spark might be the result of frictional electricity from moving parts of machinery or from frictional electricity that has collected in the air.

5. Copper wire is a good conductor of electricity and does not get hot enough to give off light. Tungsten gets white-hot because electricity does not easily flow through this kind of wire.

EVALUATION

In summing up the discussion about electricity, make children aware of social implications. Help them to appreciate how man's use of electricity has changed civilization.

Evaluate changes in behavior. Are boys and girls observing more accurately? Do they show evidence of critical thinking? Are they using the scientific method?

Your class may wish to make records of their experiences with electricity. Collect these for a book about electricity. Watch for misconceptions and incorrect conclusions. Stress the necessity for checking experiments by repetition and by referring to authoritative information.

A test of this type may help you to evaluate the learning of facts. Even though mastery of some facts is necessary, remember that fact-gathering should play a minor part in the learning process.

Let the pupil write the word *True* or *False* after each sentence. The correct words are here supplied.

1. Water attracts electricity. (*False*)
2. Lightning never strikes twice in the same place. (*False*)
3. Electricity is yellow. (*False*)
4. Air will not conduct electricity. (*False*)
5. Insulators make an easy path for electricity. (*False*)
6. Electricity flows through metals more easily than it flows through air. (*True*)
7. Lightning is a huge spark. (*True*)

8. Electricity travels very swiftly. (*True*)
9. There is an electromagnet in a doorbell. (*True*)
10. There is an electromagnet in a light bulb. (*False*)
11. There is an electromagnet in a telegraph set. (*True*)
12. The tungsten wire in a toaster becomes red-hot when electricity flows through it. (*False*)
13. The wire in a light bulb is thinner than the wire in a toaster. (*True*)
14. The wire in a fluorescent light, or "cold" light, is thinner than the wire in an ordinary light bulb. (*False*)

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

armature (är'má túr). In an electric bell the piece of metal to which the clapper is attached and which moves back and forth in ringing the bell is called the vibrating armature.

carbon (kär'bôn). One of the 96 elements of matter.

conductor (kôn dŭk'tēr). A substance through which electricity flows easily.

electromagnet (é lĕk trô mǎg'nĕt). A core of soft iron surrounded by a coil of wire through which an electric current is passed to make it magnetic.

fluorescent (flōō ô rĕs'ĕnt). When invisible rays strike certain substances, visible rays of light are emitted from the latter. These substances are said to be fluorescent, and the light produced is known as fluorescence.

frictional electricity (frĭk'shŭn ăl é lĕk trĭs'ĭ tĭ). Electricity produced by rubbing together different substances.

insulation (ĭn sŭ lâ'shŭn). Material used to prevent electricity from passing through. A nonconducting substance.

neon (nĕ'ôn). A gaseous element.

nichrome (nĭ'krôm). A metal consisting of nickel and chromium, used in heating appliances because of its resistance to electric current.

sodium (sô'dĭ ŭm). A metallic element that is easily vaporized.

tungsten (tŭng'stĕn). A somewhat rare element.

vehicle (vē'ĭ k'l). Anything used for conveying, or carrying, something.

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- | | |
|---|----------------------------------|
| A Modern Zeus, Man Conquers Lightning (GEC) | Elements of Electrical Circuits* |
| Life of Thomas A. Edison (GEC) | Development of Communications |
| Electrostatics* | Home Electrical Appliances |

*Films so marked may be somewhat advanced in treatment; hence particular care should be taken in preparing the class before presentation.

VIII. TRAVEL BY AIR

Everyone who works with children knows that the rapid developments of the air age are an important part of their world. Out of experiences with planes and through reading about them, intense interest develops, and also problems arise. These provide teachers with opportunities to help children to gain science understanding and to become more intelligent in their thinking about aircraft.

MEANINGS FOR CHILDREN

Some kinds of plants can travel in air. Most kinds of insects can fly. Flying fish and flying squirrels cannot really fly; they glide through the air. Ostriches and penguins have small wings and cannot fly. Most other birds have proper structures for flying. When birds glide, they make use of air currents. Gliding birds sink unless rising air carries them up. Birds use much energy to flap their wings for true flight. Planes without motors glide on air currents. Planes with motors use gasoline for energy. Before they can rise, planes and gliders must first travel fast along the ground so that air will move swiftly across their wings. Wings are so shaped that there is more air pressure on their undersurface than on their upper surface. If no air molecules push against the wings, a plane will sink. Most planes cannot remain still in the air. A helicopter has no wings on its sides; instead, it has a special kind of propeller that spins above the plane. Since the propeller is in constant motion, the helicopter does not sink when it stops in the air. Air travel has been greatly improved by streamlining, improved engines, and new instruments for safe flying.

GENERAL INFORMATION FOR THE TEACHER

True flight involves use of energy other than moving air. Gliding depends on air currents. This applies to living things that travel in air as well as to planes.

Gliders do not have propellers; there are no engines in gliders to turn propellers.

Balloons and dirigibles rise because they weigh less than the air. They are filled with gases lighter than air, such as hydrogen and helium. Propellers pull dirigibles forward just as propellers pull airplanes.

Kites stay in the air because of the push of molecules of air against the bottom of the kite. The air must be moving (wind) or the kite must be moving. Air molecules must be bumping against the kite or the kite must be bumping against the air molecules. Planes too must have air moving across their wings either because the plane is moving or because the air itself is moving.

The atmosphere is probably about 200 miles deep. Of this thick layer the lower 35,000 feet are referred to as the troposphere. Above this region, in the stratosphere, there is intense coldness and lack of weather. Stratosphere planes are specially built for these conditions and are used for long trips. It is not practical to climb so high for short distances.

The direction of flight of an airplane is controlled by movable sections on the wings called ailerons and by movable tail parts similar to the rudders on ships. These movable parts have the effect of changing the angles at which the wind strikes the vertical and horizontal surfaces of the plane.

An airplane is held up by the unbalanced push of molecules against the wings. Air travels over a greater surface across the upper side of the wing because the upper side is curved. The push of air molecules on the underside is therefore greater.

Planes take off and land into the wind.

Airplanes that fly slowly have broad, flat wings. Swift airplanes have flat, narrow wings. Some planes that fly at 450 miles per hour are unable to stay in the air at 150 miles per hour. Fast planes are more difficult to land.

The principle of the rocket can be illustrated by untying the mouth of a balloon and setting the balloon free.

POSSIBLE APPROACH

Pages 201-214. You might introduce this chapter by asking children in a discussion group to name as many animal and plant

air travelers as they can. Or you might ask why people cannot travel in the air without airplanes. Or use the picture on page 200.

Lead children to their books for further information.

For homework you may wish to ask children to group gliding animals and flying animals. Talk about the difference between gliding and flying. Encourage children to draw their own conclusions about characteristics necessary for flight. Let them discover that flying animals have light bodies, and wings which cover a large surface. After such a pattern men built their planes.

Pages 214-220. The amount of interest in air travel varies within groups. Many boys and girls make model planes. Some children in your class may have traveled in a transport plane. Here is an opportunity for children to share their experiences.

Encourage children to bring their model planes to school. Use them to help children to understand the principles of gliding.

Pages 220-227. If model planes with motors are available, your group can experiment with them. Compare these planes with flying animals.

Let each child do the experiment on page 223. Compare the shape of the paper with the shape of plane wings.

Pages 227-234. These pages supply material for reading and discussion. Stop frequently to question and to exchange information which children have gathered from reading and observation.

MATERIALS NEEDED

Model planes (supplied by children or purchased at five-and-ten-cent store); insects for observation (see page 203 of text for ways to attract insects); paper and scissors; a collection of seeds that travel through air, if possible.

What Do You Think? (p. 235) 1. Automobiles and trains do not have wings to create the unbalanced air pressure that causes lift.

2. Air travel has made miles seem shorter. If you measure a mile in walking time, your answer will be 20 minutes. If you measure a mile in flying time, your answer will be 20 seconds or less.

3. The first airplane was not a result of luck but of very hard work which lasted for a long period of time. The Wright brothers used the information gathered by former experimenters and added to it. Great inventions are not brought about by just luck. They are the result of persistent effort and hard thinking.

4. Birds face the wind when they begin to fly, just as airplanes do. The wind blowing past their wings helps to lift them.

More Things to Do (p. 235). No answers necessary.

EVALUATION

Try to arrange a visit to an airport. Through conversations during the trip and from class discussion you can discover the ideas which children have about air travel.

You may wish to invite another class to hear reports about the trip or about material discussed in this chapter. Children with special ability might choose subjects which have not been discussed by the class, such as lighter-than-air craft, parts of a plane, speed of planes, new travel routes, and air-age maps. These reports will give you an opportunity to evaluate children's learnings.

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

clematis (klēm'ā tīs). A flowering vine.

helicopter (hēl'ī kōp tēr). An airplane that depends for flying not upon wings but on a revolving propeller above the plane. The word comes from the Greek *hēlix*, "spiral," and *ptērōn*, "wing." It is not related to the Greek word *hēlios*, meaning "sun"; hence the *e* in the first syllable is short (*hēl* not *hēl*).

Leonardo da Vinci (lā ō nār'dō dā vēm'chè). A famous Italian painter.

penguin (pēn'gwīn). A flightless bird of the Southern Hemisphere.

radar (rā'dār). A device by which navigators in the air or on the sea can detect the presence and determine the position of near-by objects hidden from the eye by fog, clouds, or other obstruction.

rotor (rō'tōr). The propeller of a helicopter, which revolves above the aircraft.

stratosphere (strā'tō sfēr). The region of the atmosphere above 35,000 feet, marked by the absence of storms.

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- LUBE, T. F. *How Planes Fly*. Harper, 1943.
- LUBE, T. F. *Parts of Planes*. Harper, 1943.
- MCCCLINTOCK, MARSHALL. *Airplanes and How They Fly*. Stokes, 1943.

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- Air-Age World*, Upper Edition. 10 cents per pupil for four issues. Also free booklets and maps (enclose 10 cents to help defray mailing costs). Air-Age Educational Research, 100 East 42d Street, New York 17, New York.
- What Your Town Needs for the Coming Air Age*. Free. Also teacher's kit, \$1.00; contains charts and pamphlets. Piper Aircraft Corporation, Lock Haven, Pennsylvania.
- Information about air express. Railway Express Agency, Inc., Department of Public Relations, 230 Park Avenue, New York 17, New York.
- Aviation kits for grades 4 to 6. 25 cents. Also free materials. United Air Lines, School and College Service, Palmer House, Room 305, Chicago 3, Illinois.

FILMS

- | | |
|-------------------------|-------------------------|
| Seed Dispersal | Theory of Flight* |
| Thrushes and Relatives | An Airplane Trip (AMNH) |
| Birds of the Sea (AMNH) | |

*Although somewhat advanced in treatment, this film may be suitable for some groups. In any event it should be carefully previewed by the teacher before presentation.

IX. USEFUL FACTS ABOUT LIGHT

Children have experiences with light every day of their lives. Many children are aware of luminous objects, but they do not consider reflected light. Without reflection the world would be a very different place. For instance, if light were not reflected from a printed page, we should be unable to read. We should be unable to observe most of the things in our environment.

Light behaves differently when it strikes surfaces of various compositions. We make use of this fact in many ways.

MEANINGS FOR CHILDREN

Most sources of light are hot. Some animals produce "cold" light. Man can make paints that glow in the dark. All light reaches us either directly or by reflection. Bright sources of light and bright reflections may injure eyes. Mirrors are smooth, shiny surfaces which reflect light evenly and reverse images. Rough surfaces scatter light. We must be careful to use the right kind of light for work and play.

GENERAL INFORMATION FOR THE TEACHER

We see most objects because light travels from its source to them and is then reflected to our eyes. Light travels at a speed of 186,000 miles a second.

Most sources of light are hot. Lights produced by living organisms, neon lights, and fluorescent lights are comparatively cold.

A rough surface will scatter light by reflecting it in many directions.

A smooth surface reflects light in an even and regular way, making a mirror. The angle of reflection is equal to the angle at which light strikes the surface.

Reflections of objects from curved mirrors may be very different from the appearance of the objects themselves.

We use flat mirrors to make rooms appear larger and lighter. We use curved mirrors in stage lights, telescopes, and microscopes, and in lighting air fields.

There is no connection between breaking a mirror and "seven years of bad luck."

Refraction is the bending of light as it passes from one medium into another. Light travels faster in air than in water.

POSSIBLE APPROACH

Pages 237-255. Consider the following questions and discuss them with the children: Why can you see the floor of the room you are now in? Is the floor a source of light? Do we see because light travels from our eyes to the floor? Is all light hot? Read pages 238-244 to find the answers to the questions.

Encourage children to ask other questions about light. Talk about mirrors. What makes a mirror? Why can you not see yourself in the floor of your room? Are all mirrors made of glass?

Allow individuals to do the experiments on page 247. Watch for evidences of understanding.

Page 255. Encourage children to check the sources of light where they study at home.

ADDITIONAL ACTIVITIES

1. Place a pencil in a glass of water. The pencil will look broken at the surface of the water. The part under water will appear to be larger than the top of the pencil. The pencil appears this way because light rays are bent as they pass from the air into the water. This is known as refraction.

2. Place a coin in a pan and move away from the pan until the coin just disappears. Ask someone to stand at this place. Now carefully pour water into the pan without disturbing the coin. Ask the person to watch for the money "you are making." The coin will appear because the light rays are bent as they travel through the water. This is another example of refraction.

We make use of refraction in reading glasses, telescopes, compound microscopes, field glasses, and projection lanterns.

3. In a darkened room let light from a flashlight or a projection lantern strike a mirror. Clap blackboard erasers so that chalk dust will show the path of the light.

4. When you go to your bedroom tonight, take a roll of adhesive tape with you. Turn out all the lights and wait a few minutes until your eyes become accustomed to the dark. Strip the tape quickly from the roll. You will see a beautiful greenish light which is similar to that of the firefly.

What Do You Think? (p. 256)

1.

Sources of Light

fixed stars
sun
fire
electric light
firefly
some deep-sea fish

Objects Which Reflect Light

books	clothing
pencils	walls
floors	ground
ceilings	rocks
people	grass

2. In a world where nothing reflected light one would see only those things which are sources of light. People would not be able to see one another. They would not be able to read or to see most of the material objects all about them.

3. If all surfaces were smooth and shiny, glare would be greatly increased and all objects would be mirrors. This would be very confusing and harmful to eyes.

4. Jane would see Ann since light strikes and leaves a mirror at equal angles. Joe would see Bill and Bill would see Joe. Ann would see Jane. John would see himself.

More Things to Do (p. 256).

3.



4. Fluorescent lighting which, like the glow from certain animals, is "cold" light.

EVALUATION

Use "What Do You Think?" and "More Things to Do" as one way to evaluate learnings children have gained through a study of this chapter. Encourage discussion of these questions and watch for misconceptions. Help children to draw conclusions from their discussion.

Here is a picture test for children.

1. Pretend that you can see only those things which are sources of light. Draw a picture to show the way your room would look to you.
2. Draw a picture to show how light is reflected from a rough surface.
3. Draw a picture to show how light is reflected from a smooth pond.

In addition to this you may wish to use the following true-false test. The correct answers are supplied.

1. Shiny surfaces reflect light better than dull ones. (*True*)
2. Smooth surfaces scatter light in all directions. (*False*)
3. A broken mirror will not cause seven years of bad luck. (*True*)
4. The angle at which light strikes a surface is equal to the angle at which it is reflected. (*True*)
5. Some curved mirrors magnify an object. (*True*)
6. Reflected light may be bright enough to injure your eyes. (*True*)
7. The clearest reflections come from objects that are shiny and smooth. (*True*)
8. Mirrors are a good source of light. (*False*)
9. A mirror facing a window will make a room lighter. (*True*)
10. Illumination means "lighting." (*True*)

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

arc light (ärk lit). A very bright light, accompanied by intense heat, that is produced by an electric current passing through a gap between two terminals, or conductors.

aviator (ä'vĩ ä tēr). A person who flies an airplane or is otherwise expert in aviation.

illumination (ĩ lũ mĩ nã'shũn). The act or process of making light.

larva (lär'vã), *plural larvae* (lär'vẽ). The wormlike form of the young of insects that undergo metamorphosis, or change from one stage to another.

periscope (pěr'ĩ skōp). An optical instrument by means of which men in a submarine can see above water without surfacing the ship.

radium (rā'dī ūm). A metal that gives off light as a result of atomic disintegration. It is one of the rarer elements of matter.

reflection (rē flēk'shŭn). A bending back, or return, of light from an object upon which it has fallen from a source. Thus the light of the sun falls upon the moon and is reflected from the moon.

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National Geographic Magazine, June, 1931: "Luminous Life in the Depths of the Sea."

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Free materials from General Electric Company, Nela Park, Cleveland 12, Ohio, and from Better Vision Institute, Inc., 630 Fifth Avenue, Rockefeller Center, New York 20, New York.

Write for catalogue of free and inexpensive publications on eye health and protection from National Society for the Prevention of Blindness, 1790 Broadway, New York 19, New York.

Light in Your Life. Little Science Series. Free in quantity. Westinghouse School Service, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

FILM

Light Waves and Their Uses

X. SOUNDS ALL ABOUT US

Sound affects the lives of everyone. Some sounds are pleasant and helpful; others are unpleasant and distracting. Children should be made aware of the fact that men can do much to control the kinds and amount of sound in their lives.

MEANINGS FOR CHILDREN

Without motion there is no sound. All sound is produced by vibration. Loudness of sound depends on the amount of force that causes an object to vibrate or the amount of air set in vibration by the vibrating object. Pitch varies with the speed of the vibrations. Some movements are too fast or too slow to be heard, because they produce such high or low tones. Many kinds of animals can produce sounds. Some animals have vocal cords. Even though animal sounds vary, they are all produced by vibrations. Animals hear by perceiving vibrations, too. Man has learned to protect his ears. He has learned to prevent some of the unpleasant noises.

GENERAL INFORMATION FOR THE TEACHER

All sound is caused by vibration.

Sound travels in waves which move out in all directions from the thing that is vibrating. Sound waves can be reflected. When they strike an object more than 60 feet away, we hear this reflection as an echo.

Sound travels about one fifth of a mile per second. Sound travels more slowly than light and electricity.

The loudness of a sound depends on the amount of force that causes an object to vibrate or upon the amount of air set in vibration by a vibrating object. Sounding boards can be used to increase the volume of a sound.

Pitch means highness or lowness of sound. Pitch depends on the speed of the vibrations. Decreasing the length of a column of air or of a string raises pitch. Strings and air columns of small

diameter vibrate faster than those of larger diameter and therefore have a higher pitch. Tightening a string will raise its pitch.

On phonograph records a needle travels in a groove, which makes it vibrate. The needle makes a diaphragm vibrate, which, in turn, makes air vibrate so that we hear sounds.

People are the only animals who can talk to one another with words. Parrots do not understand the meaning of what they say. They "talk" by imitation.

The human ear is composed of three parts: the outer ear, the middle ear, and the inner ear. The outer ear gathers sound waves, which are sent to the eardrum. The eardrum vibrates, and then three small bones in the middle ear vibrate. Thereupon the vibrations are carried to nerves in the inner ear, and these carry the message to the brain.

The Eustachian tube helps to equalize the air pressure on both sides of the eardrum. When one is in a tunnel or in an airplane, swallowing will help to equalize the pressure.

The wind whistles around corners when the air is moving at a speed that sets up vibrations which we can hear.

POSSIBLE APPROACH

Pages 259-262. You can begin a discussion about sound by asking your class if they know of a perfectly quiet place. Make a list of all the sounds which are heard in your room during one minute while children are getting out books. Ask boys and girls to suggest causes for these sounds. The material on pages 259-262 will help them to understand that all sound is caused by vibration.

Ask the children who play musical instruments to bring them to school. Let them show how they tune their instruments. Encourage children to make musical instruments.

Pages 262-267. Experiments on pages 263-264 will help to show why sounds differ. Give your children an opportunity to learn through these firsthand experiences. Allow time for repetition of experiments. Does the same thing happen if an experiment is repeated? Does everyone get the same results? Help children to

develop the habit of critical thinking and of checking experiments with authoritative information. Experiments will then be more meaningful to them.

Pages 267-277. Many children are curious about animal sounds. Here are examples of children's questions: Why can't insects talk? Which animals can hear? Can animals hear without ears?

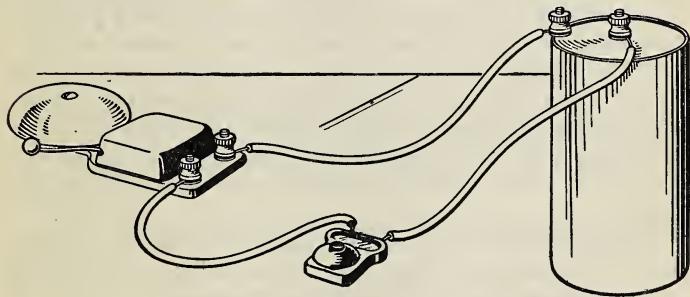
Let children talk freely about animals that make noises. Use pages 267-270 to conform or correct and supplement these ideas.

ADDITIONAL ACTIVITIES

1. Fill a large pan or an empty aquarium with water. After the water is perfectly still, add another drop of water at the center of the surface. Watch the ripples. Compare them with vibrations.

2. Plan an experiment to find out if sound can travel around corners.

3. Strike a tuning fork gently and hold it in a pan of water. Notice the splashing which is caused by the vibrations.



4. Connect a dry cell, a push button, and an electric bell. Touch the gong while the bell is ringing, to feel the vibrations.

5. Measure your school auditorium to see if it is long enough for echoes. If the room is less than 60 feet from wall to wall, sound waves are sent back from the wall so soon that a shout and its echo seem to be one sound. If the room is large enough for echoes, see what is being done or has been done to prevent them.

6. Compare the pitch of tuning forks of various sizes. The numbers on the tuning forks tell how many times the prongs vibrate in one second.

7. To make a sounding board, remove the ends from a cigar box and close the lid of the box. Strike a tuning fork and stand it on the lid.

8. If you can collect some crickets, katydids, or grasshoppers, examine them to see the parts which vibrate when the insects "sing."

9. Collect bells of different sizes and play a tune with them.

MATERIALS NEEDED

Musical instruments (as many kinds as possible); blades of grass for each child; tissue paper and combs; tablespoon; teaspoon; light-weight string (about 3 feet); soda-water bottles, several sizes; tuning forks, various sizes, if possible.

What Do You Think? (p. 277) 1. If people could not talk, they would be unable to learn from each other. Written language would be lacking and man's state of civilization would be very primitive. Permanent records might still be in the form of picture writing.

2. The number of moving objects is tremendous. If each one made a sound that human ears could hear, the world would be a very noisy and unpleasant place. Suggest that children note all the motion in a room for one minute. Ask them to imagine how much noise there would be if each moving object produced a sound.

3. Sounds differ because of the composition of the vibrating object, the size of the object, the amount of force causing the object to vibrate, and the speed of the vibrations.

4. Since spoken language can be transmitted for long distances by telephone and radio, many people can hear a message from one man simultaneously. Educational and recreational programs reach large audiences. We have more opportunity to understand our neighbors better throughout the world.

5. By cupping their hands around their ears people collect more sound waves. More vibrations reach their eardrums.

6. If nothing vibrates, there are no sound waves to travel to your ear.

7. The contrabasso will play the lowest note because it has the longest string. Pitch varies with length of the vibrating object.

8. See page 276 of text.

More Things to Do (p. 278). 2. When the right pedal is pushed down, the felt dampers are removed from the strings so that, when the keys are struck, the notes continue audible for some time thereafter. (The two upper octaves are always free; there is no felt on them.) The left pedal works differently on grand and upright pianos, thus:

Grand piano: The left pedal is the soft pedal, which moves a little to the left or to the right so that the hammer for a note hits only one or two of the three strings. Normally three strings are struck by the hammer when the key is pressed down.

Upright piano: The left pedal pushes all hammers closer to the strings. When a key is struck, the hammer moves a shorter distance, and the vibration of the string is not so great; hence the sound is softer.

EVALUATION

Watch for evidence that children are applying what they have learned. Are they trying to improve their voices? Are they aware of unnecessary noise? Do they suggest possible ways of controlling it?

You may try the following test. The statements are marked correctly.

1. When you strike a drum hard, the sound is higher than when you hit the drum gently. (*False*)

2. Everything that moves makes a sound that you can hear. (*False*)

3. Heavy curtains absorb sound. (*True*)

4. The loudness of a sound depends on the amount of force that causes an object to vibrate. (*True*)

5. Both music and noise are caused by vibration. (*True*)

6. In every musical instrument there is something that vibrates to make a sound. (*True*)

7. All animals have vocal cords. (*False*)
8. Sound waves move in all directions from a vibrating object. (*True*)
9. A very loud noise may break a person's eardrum. (*True*)
10. Some animals have no ears. (*True*)

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

bacteria (băk tēr'ĩ ä), *singular* bacterium (băk tēr'ĩ ũm). Microscopic plants.
 eardrum (ēr'drŭm). The vibrating membrane of the ear.
 membrane (mēm'brân). A thin layer of tissue.
 oboe (ō'bō). A musical wind instrument resembling a clarinet.
 pitch (pĭch). The highness or lowness of a sound, depending on the speed of the vibrations.
 vellum (vēl'ŭm). Parchment, made of an animal skin.
 vibration (vī bră'shŭn). Movement back and forth of an object.
 vocal cords (vō'kāl kôrds). The membranous folds in the larynx that produce voice.

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For the Children

- HUEY, EDWARD G. *What Makes the Wheels Go Round*, pp. 131-140. Reynal, 1940.

FILMS

Sound Waves and Their Sources*

Fundamentals of Acoustics*

*Films so marked may be somewhat advanced in treatment; hence particular care should be taken in preparing the class before presentation.

XI. THE WATER WE DRINK

The purpose of this chapter is to help children to realize the importance of safe water for domestic use. Children should develop an awareness of the problems involved in maintaining a satisfactory water supply in rural and urban communities, and particularly in the community in which they live.

MEANINGS FOR CHILDREN

Most of the world is covered by salt water which is unfit for drinking. Drinking water comes from rain. People on farms get water from springs and wells. Cities get water from lakes, rivers, and mountain streams. Water travels long distances from mountains to cities and rises in the water pipes in buildings. Sometimes pumps must be used to send water into buildings. Almost all drinking water must be purified. Wells should be so constructed that germs cannot seep into them. Chemicals are used to purify some water supplies.

GENERAL INFORMATION FOR THE TEACHER

There is very little pure water in the world. Most water contains foreign matter, but these impurities are not necessarily harmful to the human body. Drinking water may be very impure yet safe.

Distilled water is the purest form of water, but it is used for drinking only on ocean liners. The cost of evaporating water and collecting this water after it has condensed would be prohibitive for larger supplies.

The fishy taste which sometimes occurs in water is caused by the presence of certain microorganisms. Although these are not usually harmful, if they are killed by the addition of copper sulfate the water will not have an unpleasant taste.

Minerals such as calcium, iron, and magnesium or the gas hydrogen sulfide may give an unpleasant color or taste to the water without making it unfit to drink.

Human and animal excrement are likely to contain germs which make the water unfit to drink. Typhoid, dysentery, and cholera are water-borne diseases.

Bacteria and the organic matter upon which they feed are killed by the use of one or more of the following means: sunlight, boiling, aeration, and use of chemicals, such as chlorine, ammonia, and ozone. Other impurities (inorganic matter) are removed by filtration, sedimentation, and coagulation.

Household filters are not reliable water purifiers. It is probable that no type of household filter entirely frees water from germs.

Compounds of calcium, iron, and magnesium dissolved in water make the water hard. Such water will not produce suds easily, will curdle soap, and will leave a scum on materials. Water-softeners, such as washing soda, borax, and trisodium phosphate react with the compounds in the water to soften the water.

POSSIBLE APPROACH

Pages 281-284. Introduce this chapter by asking children to theorize about sources of water supply for various communities, including their own. Children may wish to form committees with certain responsibilities for gathering information about the problems they select.

You may wish to use this chapter in connection with social-studies materials. Various children may write to cities and towns to secure information about sources of water supply. Have them address the Water Commissioner, Department of Public Works, in the community in which they are interested. Then by marking on a map identify cities that obtain water from lakes. A small paper flag on a pin will serve as a marker. Use a different color to represent those cities that obtain water from rivers and still another color for those cities that depend on mountain streams.

Pages 284-294. While waiting for answers to letters, let groups of children do the experiment on page 286. Then discuss problems of water purification. Let the class investigate this problem in your own community.

Perhaps you can arrange to visit the source of water supply for

your community and a water-purification plant. Arrange with the plant before your visit to see if someone will guide your class through it. Encourage the class to talk about the questions they hope to answer by such a trip.

ADDITIONAL ACTIVITIES

1. Ask someone who has traveled on an ocean liner to tell you about the water supply on ships.

2. Experiment with a water-softener. Using equal amounts of water in two dishes, add a water-softener to the water in one dish. Add an equal amount of soap to both dishes and stir. Measure the suds on top of the water in each dish.

Collect some rain water and repeat this experiment to see if rain water is soft. Rain water, except for some dust particles which it contains, is the same as distilled water.

MATERIALS NEEDED

Funnels (two per group); rubber tubing or hose to fit funnels (about 3 feet per group); large pan or bowl for washing in salt water; pan in which water can be boiled; two dishes, metal or crockery.

More Things to Do (p. 294). No answers necessary.

More Things to Find Out (p. 295). 1. Several methods for converting salt water into fresh water are used by aviators who crash at sea. Certain chemicals in tablet form are used, and a still which uses heat from the aviator's body evaporates ocean water and collects the pure water when it condenses.

EVALUATION

Participation in a map project and general class discussion will help you to evaluate children's progress. Look for improvement in the individual's ability to work with others, to handle materials, and to gather and organize information.

You may wish to supplement this evaluation by using a test of this type:

Part A.

1. Cities get their drinking water from _____, or _____, or _____. (*rivers, lakes, reservoirs*)
2. Water flows to faucets high in buildings because _____. (*it has been pumped or it flows down from a hill and up again*)
3. _____ is a chemical which is used to kill germs in water. (*Ammonia or Chlorine*)
4. _____ removes mud from water. (*Filtering*)
5. _____ removes salt from water. (*Evaporation*)
6. Water may be purified by boiling it for _____ minutes. (*twenty*)
7. Germs which cause _____ may be carried by water. (*typhoid disease*)
8. Boiled water tastes _____. (*flat or has no taste*)

Part B. Draw a picture to show how new rain comes from old.

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

artesian well (är tē'zhǎn wěi). A deep, bored well.

chlorine (klō'rīn). A poisonous gaseous element.

evaporate (ē vāp'ō rāt). A liquid evaporates when it is changed to vapor.

filter (fīl'tēr). To filter a liquid is to strain it through some porous substance.

reservoir (rēz'ēr vwôr). A large body of water, purified and kept by a city or town for human use.

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Free bibliography of government material on this subject. Price List No. 51.
Superintendent of Documents, Government Printing Office, Washington,
D. C.

Free booklets on water purification. Wallace and Tiernan Company, Inc.,
Newark, New Jersey.

FILMS

City Water Supply
Clean Waters (GEC)

XII. SAVING THE SOIL

Children in both urban and rural communities need to develop an appreciation of soil as a resource. There is a direct relationship between living conditions and the condition of the soil in many areas. It has also been shown that there is a relationship between soil and health.¹ An awareness of the importance of soil conservation should be developed among all the children of our nation.

MEANINGS FOR CHILDREN

Soil is always changing. New soil is being formed from rocks by sudden changes in temperature, by ice in cracks of rocks, and by chemicals in stream water. Glaciers, volcanoes, wind, water, and plants are helping to make soil. Soil is made slowly. Man has used the soil unwisely, and, as a result, much of our topsoil has been washed and blown away. With scientific farming man is learning to conserve the soil. He is planting crops which have roots to hold the soil in place. Strip cropping, contour plowing, and terracing are other methods which are being used to prevent further loss of topsoil. Good soil is important to all of us. We must be aware of the soil problem.

GENERAL INFORMATION FOR THE TEACHER

Soil is composed of decaying organic matter and particles from various kinds of rock. The organic matter supplies raw materials for food-making by plants.

When corn, cotton, or similar crops are planted in a field year after year, they deplete this supply of organic matter. Enormous amounts of nitrate fertilizer must be added.

On the other hand, certain plants add nitrates to the soil. Soybeans, clover, cowpeas, beans, peas, vetch, and alfalfa belong to a plant family called legumes. Bacteria that live on the roots of legumes convert nitrogen from the air into the nitrates which enrich the soil.

¹Gerald S. Craig, *Science in Childhood Education*. Bureau of Publications, Teachers College, Columbia University, New York, 1944.

More than 85 per cent of the agricultural land in the United States is affected by soil erosion. Erosion has ruined about fifty million acres of cropland so that it can no longer be used for practical cultivation. Another fifty million acres are bordering on the same condition. From one half to all the topsoil has been washed from an additional one hundred million acres. Three billion tons of soil is enough to fill a train of freight cars girding the earth eighteen times at the equator. That is the amount of soil washed or blown from fields and pastures each year.

Erosion is a problem for city people too. A farm with good soil will support five or six city families. A farm where soil is partially eroded will supply food for only two or three families. When topsoil is gone, farmers can support only themselves. In some cases even the farmers' families must depend on others.

Erosion has cost the American people more than 400 million dollars in a single year. In addition to this, millions of dollars are being paid to dredge streams and harbors filled with the debris of erosion. Floods resulting from erosion cause serious damage. Silt collects behind dams used for power and water supply. Directly or indirectly, erosion is costly to all the people.

Good soil is one of our greatest natural resources. It should be used wisely.

POSSIBLE APPROACH

Pages 297-308. If you live in an agricultural region, the children in your class will be conscious of the importance of soil. If you live in the city, you may wish to discuss man's dependence on the soil. Before one can become interested in soil conservation, he must have an appreciation of the soil itself. A question about the most important materials in the world may stimulate discussion about the importance of soil. Man could live without money, clothing, and machinery, but not without soil. We depend directly or indirectly on this natural resource for all our food. New processes developed by chemists use farm crops and wastes as basic raw materials for the production of synthetics to replace exhaustible materials, such as oil, gas, coal, and metals.

Ask your group about the composition of soil. Take the children to a field or park to examine the soil. Look at handfuls from various places. Talk about the rock particles and the decaying plants and animals that make the soil. Compare the color and the depth of soil in different sections. Consider the problem of soil formation.

Encourage questions about the soil. Ask someone to make a list of "Things We Want to Know." Let children propose methods for finding this information.

Pages 308-324. After children have an understanding of the soil itself, lead them to their books for the story of the changes in topsoil in the United States. Our ancestors should not be blamed too much for their mistakes in the use of topsoil. They did not realize the need for conservation. Today we are aware of this problem and understand more about scientific use of the soil.

Take your class outdoors as much as possible to look for places which are losing topsoil. You may find them in your school yard, a garden, a park, or a vacant field. Let children suggest methods for preventing this loss of soil.

Look for windbreaks. Many farmers plant rows of trees to protect their fields from wind.

Take a walk after a hard rain. Look for places where soil has been moved from one place to another.

ADDITIONAL ACTIVITIES

1. Investigate the history of the soil in your region. Your local librarian may be able to help.

2. If you can contact a farm agent, discuss with him the agricultural problems of your vicinity.

3. If you live in a section where glaciers once covered the land, look for marks which they have made and for large rocks which they have left.

What Do You Think? (p. 324) 1. The size of the Dust Bowl has been reduced through the combined efforts of farmers and government. Scientific farming has helped to replace needed minerals

and has supplied roots to hold the soil. See pages 316-324 of the text.

2. Rain is caught in the pockets which are made in the waffle pattern. The water sinks slowly into the soil instead of running off and taking topsoil with it.

More Things to Do (p. 325). 1. About 960,000 tons of soil are carried away in one day. In 365 days, or one year, about 350,400,000 tons.

2. Sandstone grinds easily.

3. Soil is made from pieces of rock and decaying plant and animal matter.

4-7. No answers necessary.

EVALUATION

The awareness of children of the problem of soil conservation will show you how much they have profited from their study of soil.

Here is a test which will give you some idea of subject-matter learnings. The correct answers are supplied.

1. _____, _____, _____, _____, and _____ help to break rocks and make them part of the soil. (*Glaciers, acid and water, plants, sudden changes in temperature, water freezing in cracks of rocks*)

2. _____, _____, _____, _____, and _____ have made rapid changes in the soil. (*Cutting forests recklessly, plowing land unwisely, one-crop farming, grazing animals, water and wind erosion*)

3. _____, _____, _____, _____, and _____ are plants which can be used to hold the soil. (*Clover, alfalfa, grass, grains, trees*)

4. _____, _____, _____, _____, and _____ are ways to hold the soil. (*Terracing, contour plowing, strip planting, planting grasses*)

5. Soil is made from _____ and _____. (*broken rocks, decayed plant or animal matter*)

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

carbon dioxide (kär'bŏn dī ōk'sīd). A heavy colorless and odorless gas.

glacier (glā'shēr). A slowly moving mass of ice flowing down from a region where there is much snow and great cold.

humus (hū'mŭs). That part of soil which was formed from decaying plant or animal matter.

Paricutin (pä rē'kōō tēn). A new volcano in Mexico.

pioneers (pī ō nērs'). Those who go before others to prepare the way for them, like the first people to cross frontiers to go into strange lands.

terraces (tēr'is ēz). In farming, terraces are sloping steps built on the sides of hills to prevent erosion.

volcano (vōl kā'nō). An opening in the crust of the earth through which hot molten rock, called lava, pours.

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AREY, CHARLES K. *Science Experiences for Elementary Schools*, Chap. III. Teachers College, Columbia, 1942.

LORD, RUSSELL. *Behold Our Land*. Houghton, 1938.

For the Children

National Geographic Magazine, June, 1945, pp. 641-680: "China Fights Erosion with United States Aid."

BOOKLETS

Free booklets on conservation. (Specify your field of interest, such as soil, wildlife, etc.) American Wildlife Association, Investment Building, Washington 5, D. C.

Free leaflets and teachers' manuals on conservation. (Specify grade level.) Missouri Conservation Commission, Jefferson City, Missouri.

Miscellaneous Publication No. 446. A bibliography of free and inexpensive publications and films. United States Department of Agriculture, Washington, D. C.

FILMS

Wearing Away of the Soil
Work of Running Water
Work of the Atmosphere
Geological Work of Ice

Volcanoes in Action
Conservation of Natural Resources
The Formation of Soil (AMNH)
The River (AMNH)

Write for catalogue from United States Department of Agriculture, Motion Pictures Section, Extension Service, Washington 25, D. C.

XIII. SOUND IDEAS ABOUT HEALTH

Children can do much to improve their own health. This chapter gives information for the prevention and treatment of minor illnesses that are extremely common among children.

MEANINGS FOR CHILDREN

Germes cannot enter the body through the skin. Cold viruses spread from one person to another, entering the body through the nose and the mouth. Hookworms can burrow through the skin and eventually find their way into the intestines. Ringworm is a skin disease caused by microscopic plants. Wounds, burns, frost-bite, and skin poisoning should be properly cared for. Everyone should have a knowledge of first aid.

GENERAL INFORMATION FOR THE TEACHER

Most doctors agree that colds are caused by submicroscopic bodies called viruses. There are many kinds of viruses which cause different types of colds, but all are contagious; hence isolation is important in the prevention of the spread of colds. Statistics show that in one month more than 18 million people in the United States were troubled with colds. This figure can be greatly reduced if all of us follow the proper procedure for prevention and treatment of colds.

There are many opinions on how colds should be treated. There is no cure for colds; but doctors agree that resting in bed and drinking large quantities of fruit juices are the best procedures for helping the body to overcome cold viruses.

It is estimated that 23 per cent of the population of the United States harbor hookworms. There is no danger of hookworm disease in the northern part of the United States because hookworms become sluggish unless they are in moist soil having a temperature of from 50° to 70° F. "Ground itch" and "dew sores" mark the spots where hookworms enter the body. Usually hookworms find their way into the body through the feet. There-

fore children in the southern states should not be permitted to go barefoot.

Ringworm is a microscopic plant called a fungus which causes a disease of the skin. There are many varieties of this disease, athlete's foot being the most common. Ringworm is extremely contagious. Anyone who has ringworm should consult a physician.

There are several commercial disinfectants which can be used for treatment of minor wounds. Tincture of iodine, which is iodine in alcohol solution, is probably the most effective. A fresh 2 per cent or 3 per cent solution should be painted on the wound with an applicator. Merthiolate is another effective disinfectant. Water solutions do not sting or produce a stain, but they are less antiseptic than the alcohol solutions. Mercurochrome is a mild antiseptic which has relatively low power to kill germs. Bichloride of mercury is a disinfectant, but it is also a deadly poison and should never be kept in the family medicine closet.

Burns are classified as first-degree (skin reddened), second-degree (skin blistered), and third-degree (deeper destruction of tissue). There are many burn remedies. Two or three heaping tablespoonfuls of baking soda to a quart of water is highly recommended for any burn. Greases may be used on minor burns; but they should not be applied to extensive burns, for they may interfere with the doctor's treatment. Tannic acid has been used with excellent results. A 5 per cent solution should be made fresh when needed. Tannic-acid jelly is very satisfactory, too. Never apply iodine to a burn. Never use absorbent cotton directly on a burn because it will stick and further injure tissues.

Sunburn may be a first-degree or a second-degree burn and should be treated as such.

Frostbitten parts of the body should be warmed gradually.

A saturated solution of Epsom salts makes a lotion for treatment of skin poisoning.

General first-aid rules are given on page 342 of *New Ideas in Science*.

For additional information see *American Red Cross First Aid Textbook*, The Blakiston Company, Philadelphia, 1945.

POSSIBLE APPROACH

The material in this chapter lends itself to free discussion. Children will have many different ideas about the treatment for cuts, colds, burns, and so forth. Here is another opportunity to help children to recognize authoritative information. The advice of a physician and the information given in the *American Red Cross First Aid Textbook* should be followed instead of ideas passed from one individual to another.

ADDITIONAL ACTIVITIES

1. Learn how to treat a person who is suffering from shock. Demonstrate this procedure to your class.
2. Gather information about treatment of people who have swallowed poisons.
3. Tell the class how to prevent burns.
4. Find out what should be done if a person's clothing catches fire. Information about this is given in the *American Red Cross First Aid Textbook*.

More Things to Do (p. 343). No answers necessary.

What Do You Think? (p. 343) 1. The viruses which cause colds are probably present in the body at all times, and lowered resistance seems to be the condition favorable for catching a cold. Colds are contagious. Large numbers of viruses are spread from one person to another. To avoid colds, therefore, follow general health rules and avoid contact with people who have colds.

2. Contact with someone who has a cold; getting wet feet, sitting or sleeping in drafts, and the like are indirect causes, since they lower resistance.

3. Maintaining good posture, taking frequent baths, getting ten hours' sleep, cleaning teeth after each meal and at bedtime, taking exercise in fresh air and sunshine, and the like.

EVALUATION

After children have read this chapter, you may wish to play a game which will help you to determine what has been learned.

Ask a committee to write such words as hookworm, ivy poisoning, splinter in hand, cold, serious automobile accident, and the like on slips of paper. Let the children draw these slips. Ask each child how he or she would proceed to treat the ailment drawn. In some cases, the committee may wish to ask how a disease could have been prevented.

IMPORTANT SCIENCE WORDS IN THIS CHAPTER

contagious (kǒn tā'jǔs). Spread by direct or indirect contact with others.
lotion (lō'shǔn). A liquid medicinal preparation for washing wounds or infected parts of the skin.
sterile (stěr'íl). Free from germs.
sterilize (stěr'í liz). To make free from germs.
sumac (sū'māk). A wild-growing shrub.
tincture (tǐngk'tǔr) of **iodine** (ī'ō dǐn). Iodine dissolved in alcohol.
virus (vī'rǔs). An extremely small poisonous substance or germ.

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For the Teacher

COLE, N. and ERNEST C. *First Aid for Boys*. Appleton, 1942.
American Red Cross First Aid Textbook, Revised. Blakiston, 1945.

BOOKLETS

Health through the Ages. Health Heroes Series. Free. Metropolitan Life Insurance Company, Welfare Division, 1 Madison Avenue, New York 10, New York.
 Free publications on safety. (State age group when making requests.) National Conservation Bureau, 60 John Street, New York.
 Write for Price List No. 51 for information about booklets on health. Superintendent of Documents, Government Printing Office, Washington, D. C.
Strange Peoples of Little Worlds. Little Science Series. Westinghouse School Service, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

FILMS

Body Defenses against Disease

First Aid

XIV. USING NEW IDEAS

Use this chapter as a summary. Read it together and discuss the problems suggested here. Supplement the information with reports on the work and lives of various scientists, such reports to be the product of individual children's research.

Look for evidences of scientific thinking and attitudes. Ascertain whether the children in your group have made progress in developing the following attitudes:

Considering the authority concerning things they read and hear about

Distinguishing between fact and theory

Drawing conclusions with care

Disbelieving superstitions because they are aware that everything is the effect of a definite cause

Finding interest in scientific reading and hobbies

Trying to find out why and how things happen as they do

Listening open-mindedly to the opinions of others

Willingness to change opinions on the basis of new evidence

Looking for the whole truth in spite of personal prejudices

Increasing curiosity about one's environment

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For the Teacher

SHAPLEY, HARLOW, editor. *A Treasury of Science*. Harper, 1943.

For the Children

COMPTON, R., and NETTLES, C. H. *Conquests of Science*. Harcourt, 1939.

DE KRUIF, PAUL. *Microbe Hunters*. Harcourt, 1936.

List of Publishers

- APPLETON. D. Appleton-Century Company, Inc., 35 West 32d St., New York, N. Y.
- BLAKISTON. The Blakiston Company, 1012 Walnut St., Philadelphia, Pa.
- DAY. John Day Co., 40 East 49th St., New York, N. Y.
- FARRAR. Farrar & Rinehart, Inc., 232 Madison Ave., New York, N. Y.
- FOLLETT. Follett Publishing Company, 1255 S. Wabash Ave., Chicago, Ill.
- GINN. Ginn and Company, Statler Building, Park Square, Boston 17, Mass.
- HARCOURT. Harcourt, Brace and Company, 383 Madison Ave., New York, N. Y.
- HARPER. Harper & Brothers, 49 East 33d St., New York, N. Y.
- HOUGHTON. Houghton Mifflin Company, 2 Park St., Boston, Mass.
- KNOFF. Alfred A. Knopf, Inc., 501 Madison Ave., New York 22, N. Y.
- LYONS. Lyons and Carnahan, 2500 Prairie Ave., Chicago 16, Ill.
- MACMILLAN. The Macmillan Company, 60 Fifth Ave., New York 33, N. Y.
- NATIONAL GEOGRAPHIC. National Geographic Magazine, Washington, D. C.
- RANDOM. Random House, Inc., 20 East 57th St., New York 22, N. Y.
- REYNAL. Reynal & Hitchcock, 8 West 40th St., New York 18, N. Y.
- ROW. Row, Peterson & Co., 1911 Ridge Ave., Evanston, Ill.
- SCRIBNER. Charles Scribner's Sons, 597 Fifth Ave., New York 18, N. Y.
- STOKES. Frederick A. Stokes, 227 South 6th St., Philadelphia, Pa.
- TEACHERS COLLEGE, COLUMBIA. Bureau of Publications, Teachers College, Columbia University, 525 West 120th St., New York 27, N. Y.
- VIKING. The Viking Press, Inc., 18 East 48th St., New York 17, N. Y.
- WINSTON. The John C. Winston Company, 1006-1016 Arch St., Philadelphia 7, Pa.
- WORLD BOOK. World Book Company, 313 Park Hill Ave., Yonkers, N. Y.

Films

Unless otherwise indicated, the films mentioned in this Manual are produced and distributed by Encyclopædia Britannica Films, Inc., 20 N. Wacker Drive, Chicago, Illinois. Other educational films are available, produced and distributed for sale or rental by a number of agencies. These films are listed and classified, with brief descriptions, in a monthly cumulative catalogue, *Educational Film Guide*, compiled by Dorothy E. Cook and Eva Rahbek-Smith, and published by The H. W. Wilson Company, 950-972 University Avenue, New York 52, N. Y.

The films whose sources are indicated in the lists at the end of the chapters may be had by writing directly to the following addresses:

AMNH. American Museum of Natural History, Department of Education, Central Park West at 79th Street, New York, N. Y.

DU PONT. E. I. du Pont de Nemours and Company, Inc., Advertising Department, Wilmington, Delaware

GEC. General Electric Company, Visual Instruction Section, Publicity Division, Schenectady, New York

There is, of course, a considerable range in the effectiveness of films, and no film should be used in the classroom on the basis of title or brief description only. The teacher should become familiar with the content of the film and its suitability for classroom instruction before it is secured. In the case of films produced to illustrate industrial products or processes, one should scrutinize them for any possibly objectionable advertising.

Scientific Supply Houses

Most of the materials needed for the experiments suggested in *New Ideas in Science* can be obtained locally. If you wish to supplement your equipment, write for catalogues to the following supply houses:

Carolina Biological Supply Company, Elon College, North Carolina; Central Scientific Company, 1700 Irving Park Boulevard, Chicago, Illinois, or 79 Amherst Street, Cambridge A Station, Boston, Massachusetts; Chicago Apparatus Company, 1735-1743 North Ashland Avenue, Chicago, Illinois; General Biological Supply House, 761-763 East 69th Place, Chicago, Illinois; New York Scientific Supply Co., 111 E. 22d Street, New York City; Southwestern Biological Supply Co., 415 Tyler Avenue, Dallas, Texas; Ward's Natural Science Establishment, Inc., 302 North Goodman Street, Rochester, New York.

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